SCIENCE DIGEST

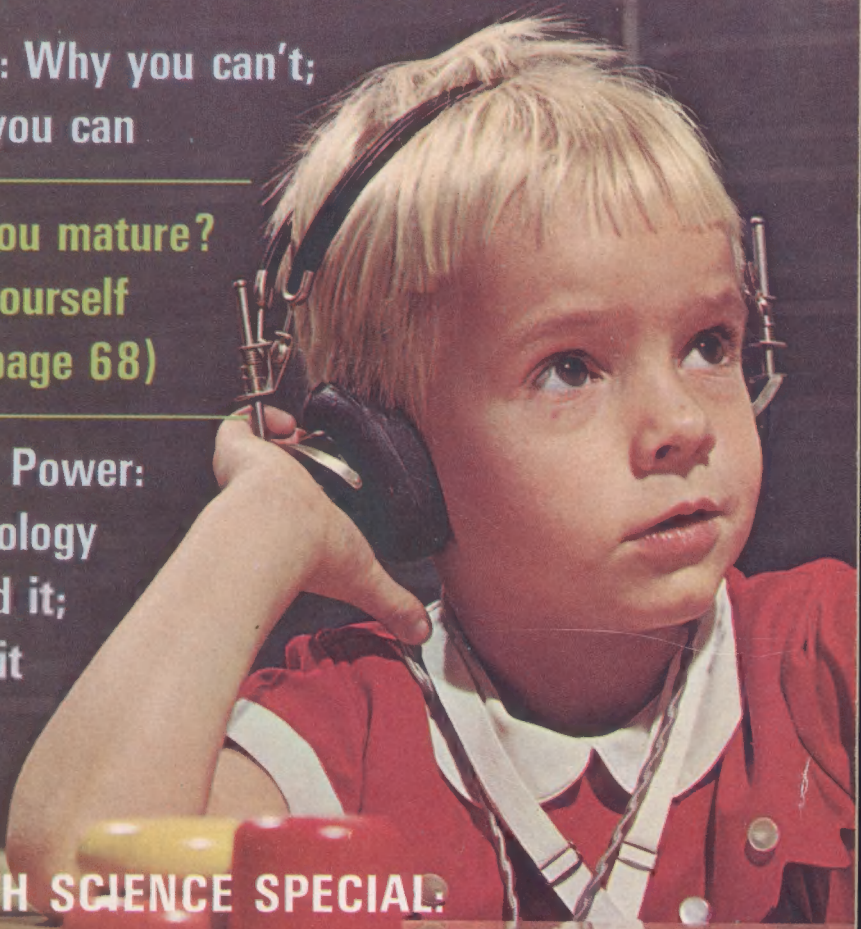
JANUARY 1968 · 50 CENTS ICD

NEW HOPE FOR THE HARD OF HEARING

Sleep: Why you can't; how you can

Are you mature? test yourself (see page 68)

Black Power: psychology behind it; what it seeks



EARTH SCIENCE SPECIAL: Continents on the move

Live virus vaccines— benefactors with a catch

A scientific look at water witching

Keystone

Only a mother could love

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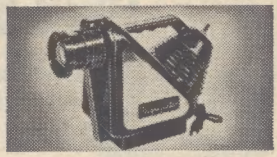

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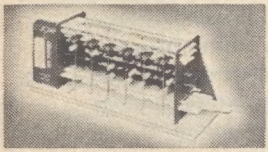

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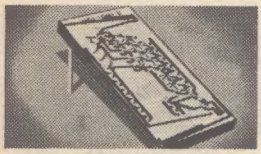

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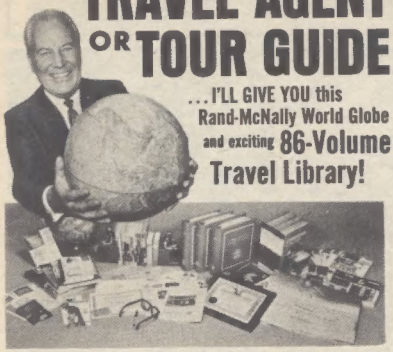

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DIGEST

Born deaf, of deaf parents, six-year-old Susan Kociuruba of West Islip, N.Y., learns to talk, read lips and interpret a few sounds that reach her through new equipment and methods at the Lexington School for the Deaf in New York. The tremendous medical advances made in the field of hearing are detailed in the story beginning on page 7.

Photo: Bryn Mawr Studios

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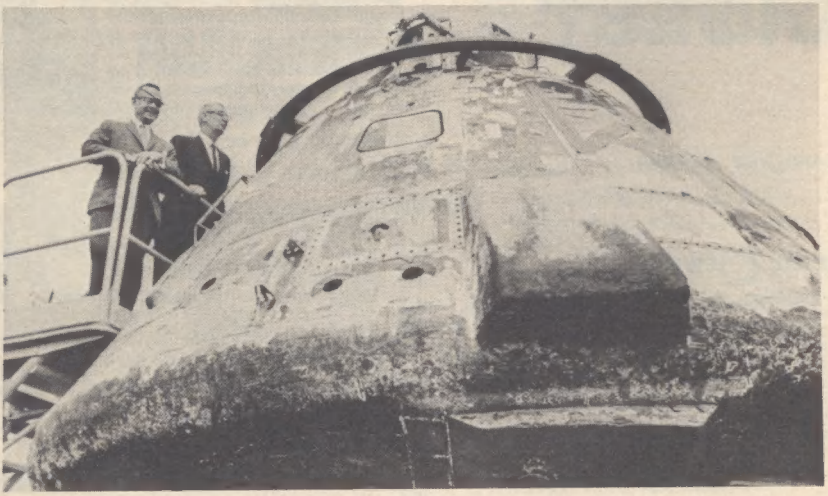

Bulletins at press time

WELCOME HOME APOLLO. When the charred Apollo command module was recovered (above) it gave the sagging spirits of the U.S. space program a big lift. The recovery was the final phase of the spectacularly successful flight of the 363-foot tall Saturn 5 moon rocket. The almost flawless maiden flight of the Saturn suddenly made the man-on-the-moon by 1970 goal look possible.

SOVIET ORBITAL MISSILE. Soviet authorities confirmed what U.S. defense officials had already indicated--that the Russians were perfecting an orbital missile that would be capable of sudden attack from a relatively low level. This type of attack would evade much of the present radar defense system. Regular ballistic missiles can be detected 15 minutes before detonation, the orbital missiles might give the defenders only three minutes warning. U.S. defense officials, stressed, however, that orbital missiles would be less destructive and less accurate than other missiles. In addition, the peril of reduced warning time would soon be offset by the deployment of over-the-horizon radar able to detect the weapons soon after they were launched.

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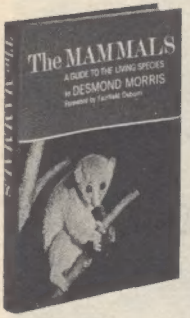

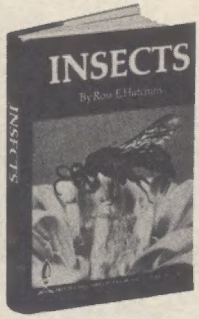

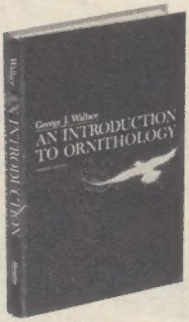

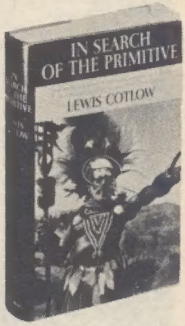

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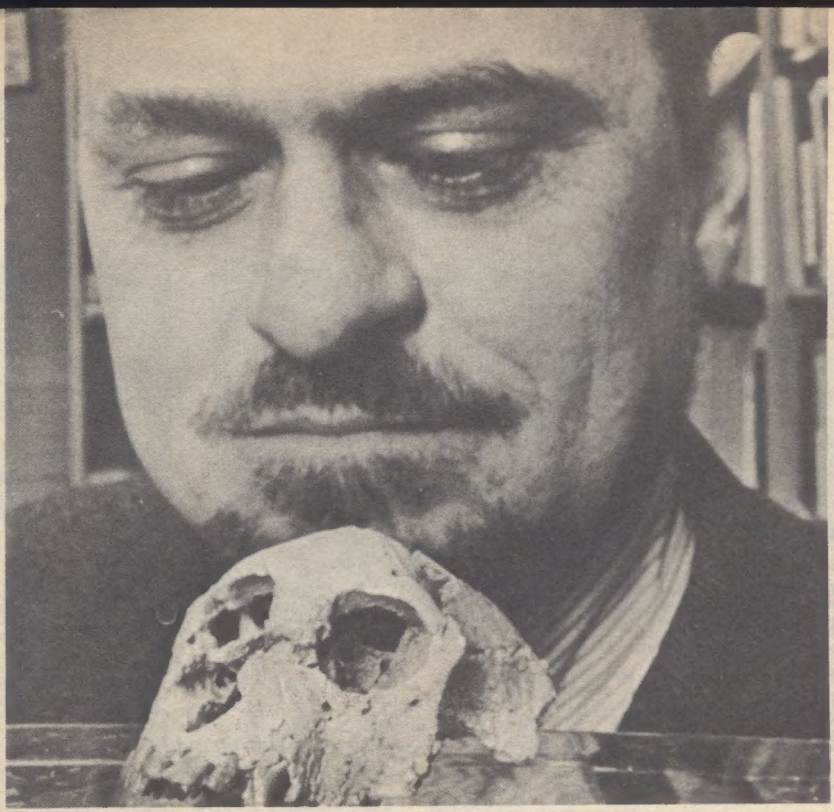
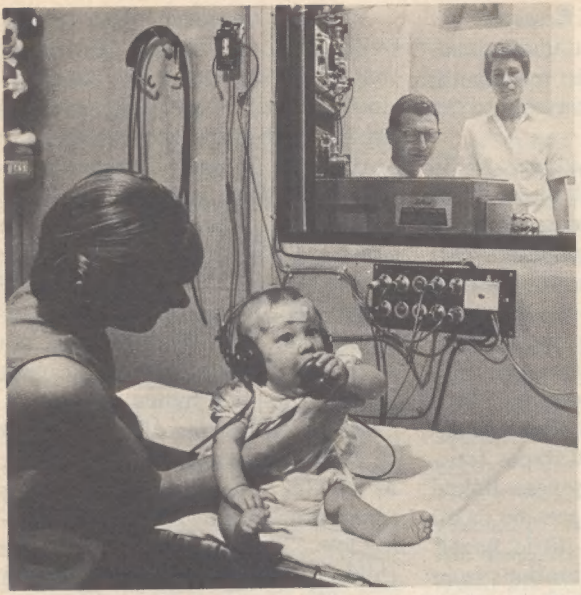


ANCIENT APE HEAD. Yale Professor Elwyn L. Simons displays the skull of an ape that is said to be some 28 million years old. The skull was discovered on a Yale expedition to the Fayum region of Egypt. Prof. Simons believes the head is 8 to 10 million years older than any other find that can be directly related to human beings.

VACCINE FROM ARTIFICIAL CELLS. Human cells grown artifically in the laboratory may become an important factor in making future vaccines against viral diseases. To make vaccines for such purposes, viruses are necessary and they multiply only when they enter living cells. Living animal cells are presently used for growing viruses for vaccine purposes with chicken and monkey cells as the most favored. But scientists have found such cells are often contaminated with other viruses, some carrying diseases (See story on page 33). Some scientists believe growing viruses in artificial human cells will lick the problem.



A mother keeps her child busy while specialists check equipment before testing infant's hearing. Slightest hearing losses can be detected with today's modern medical equipment.

New hope for the deafened

Loss of hearing takes many forms and strikes one in 10 Americans, but dramatic new advances in surgical and medical treatment promise real help for many sufferers.

by Howard G. Earl

TRY a simple experiment. As you listen to your radio or television, cup a hand behind an ear and note how the sound becomes louder. Thomas Edison was plagued with a hearing impairment and always cupped a hand behind an ear to make a bigger trap for sound.

The size of the ear, of course, is no indication of the quality of the organ of hearing. The ear is much more complicated than that. Next to the eye, the ear is the most in-

tricate organ known. Research has brought us to a better understanding of this marvelous mechanism that translates sound waves into the sensation of hearing.

The purpose of the outer ear is to trap sound waves and direct them through the outer ear canal until they strike the tympanum (eardrum) which resembles the head of a snare drum. Sound waves set the eardrum vibrating like the cover on a drum, transferring the sound to the middle ear and its ossicles, three tiny bones called the malleus (hammer), incus (anvil) and stapes (stirrup). These three bones, linked together like a chain, are too small to cover the nail of a little finger. They transfer sound vibrations from the eardrum to the fenestra ovali (oval window), the membrane-covered aperture leading into the inner ear.

The inner ear has two main parts: the upper portion, with its semicircular canals filled with fluid, gives us our sense of balance and motion. Below the canals is the cochlea, which also is filled with fluid and gives us our sense of hearing. When the oval window membranes vibrate, they agitate the fluid and this agitation is picked up by microscopic hair cells in the organ of Corti, located inside the spiral cochlea. The movement of the fluid stimulates the hair cells which convert the stimulus into nerve impulses.

This electrical energy is transmitted over the auditory nerve to the logic centers of the brain for interpretation.

It is easy to see how disorders develop in such a system. The trouble may be in the mechanism that conducts sound to the inner ear, the organ of hearing, the nerves, or parts of the brain that control hearing. Damage to hair cells or nerves often causes loss of hearing in the inner ear. In fact, ear disorders are the most common chronic physical impairment in the United States today. Some 250,000 Americans are so profoundly deaf that they cannot hear unamplified human speech.

Defective hearing affects one out of every 10 people in this country. More than 18 million Americans suffer from varying degrees of hearing loss. Three million, at least, are children, and four out of five of them are afflicted before their fifth birthday. The "invisible handicap" of impaired hearing can prevent children from pursuing a normal education or engaging in the usual childhood activities. Hearing loss also takes its toll among adults.

Three types of losses

There are three types of hearing loss—conductive, sensory-neural and central. When sound waves are not conducted properly to the inner ear, all sounds seem to be muffled, and the individual's hearing loss is termed conductive. The cause may be an obstruction in the auditory canal, perhaps an accumulation of wax, or a blockage caused by swelling and infection residue.

If sound waves do reach the inner ear but are not properly con-

Recognizing the signs of hearing loss is a major problem for most afflicted.

verted into a message that can be passed on to the brain, the loss is called sensory-neural or neurosensory. Other terms used are nerve deafness and perceptive deafness. A person with such a hearing loss generally hears low-pitched tones better than high ones. Sounds are often distorted.

Many persons with poor hearing have a mixed loss—a combination of conductive and sensory-neural impairments.

Sometimes the trouble lies beyond the ear itself. The signals from the ear may not be reaching the brain because of trouble along the acoustic nerve, or the brain may not be properly interpreting them. Persons affected in such a way are said to have a central hearing loss.

A major problem, as with the onset of any physical disability, is how one knows when he is losing his hearing. Fortunately, some danger signals have been set forth which may be used as guides. They include:

- Frequent failure to catch words or phrases.
- Experiencing more difficulty following group conversations than others around you.
- A better understanding of what a person is saying when you are facing him.
- A frequent feeling that people are mumbling instead of speaking clearly to you.
- Sounds which seem distorted when you hear them.
- A running ear, or pain, or irritation in one or both ears.
- Spells of dizziness, loss of balance, or head noises.

Fortunately, medical science is making substantial inroads on diseases and disorders which diminish or completely block transmission of sound to the hearing center of the brain.

A 45-year-old Indiana man was gradually losing all ability to hear. An otologist (ear specialist) diagnosed his problem as otosclerosis, a calcification which prevents the normal vibration of the stapes, that tiny bone in the middle ear which, when free to function properly, transmits sound waves to the inner ear. When the stapes is immobilized by a calcium deposit, it no longer conducts sound waves.

A few days after the otologist made his diagnosis, he gave the patient a local anesthetic and performed an operation known as a stapedectomy. Because the bones of the middle ear are so very small, the doctor operated while l o o k i n g through a microscope. He raised the eardrum to get across to the middle ear. He removed the stapes and fixed in its place a stainless-steel filament one-fifth of an inch long. This replacement restored sound conduction. A number of prosthesis for stapes have been devised. Bet-

ter than eight out of 10 patients have a dramatic improvement after surgery.

The fenestration operation establishes a new sound pathway to the labyrinth as a substitution for the oval window. An opening is made into the horizontal semicircular canal. This opening is covered with a skin flap which will vibrate when activated by sound. The vibrations are carried on to the nerve endings in the cochlea and on to the brain.

Ear specialists often can help many whose problem is in the mechanism that conducts sound, either in the bones of the middle ear, the ear drum, or in the outer canal. There are children born with no outer ears, ear canals or eardrums. Outer ears can be fashioned and applied as substitutes for the missing ones. If the inner ear is functioning, a complicated and difficult operation can be performed to make a new canal. A skin graft provides a new eardrum, allowing sound waves to reach the inner ear.

Surgery advances

Another advance in the treatment of middle ear disorders is the development of tympanoplasty, reconstructive microsurgery—performed while looking through a microscope. This procedure can improve the hearing of those suffering from conductive deafness caused by eardrum perforations. If accumulated infectious fluid has perforated the eardrum, the otologist can build a new one with a graft of skin from the ear canal or from the back of the hand.

A fresh development in finding the cause of hearing loss comes through special X ray equipment and diagnostic and surgical techniques used to detect and remove acoustic neuromas (tumors on the nerve of hearing) before they are large enough to involve the brain.

A chronic mastoid infection in the middle ear is a serious cause of conductive deafness, especially in children. It may be triggered by scarlet fever, allergies, head colds, measles, respiratory ailments, diseased adenoids and tonsils. The middle ear becomes inflamed with the swelling mucous membrane lining. The eardrum eventually perforates from the pressure built up by infectious fluids collecting behind it. Otologists call the infection "chronic ear" and advise that if properly and immediately attended, it can be controlled. Neglected, however, it may finally destroy part or all of the middle ear.

There is less hope for the victims of "perceptive" or "sensorineural" hearing losses. These are hearing impairments caused by malfunctions in the inner ear which is encased in the temporal bone. The inner ear, so far, has been practically inaccessible during life.

"Ear disorders caused by regular measles can be prevented," explains Dr. Gordon D. Hoople, medical adviser to the Deafness Research Foundation. German measles, which may destroy the hearing of the unborn child if the mother has the dis-

Deafened suffer varying degrees of hearing loss from different causes; deaf are born with defect.

ease during the first three months of pregnancy, may soon be prevented by a vaccine. The Rh blood factor in incompatibility between mother and child is a cause of deafness which is now well-known and can be avoided. Also preventable are disorders once caused by bacterial infections of the inner ear, and by the side effects of certain drugs.

Medical researchers know now that ear disorders induced by mumps are caused by a viral destruction of certain tissues. There is evidence that deafness caused by measles in childhood is accompanied by the degeneration of the vital sensory hair cells in the inner ear. But this type of deafness can be avoided now through measles vaccine which immunizes a child against measles.

There is a difference between the deafened and the deaf. The deafened suffer varying degrees of hearing loss through developing auditory impairment, accident, illness or the aging process. The deaf are born with the defect because of some genetic disturbance or other abnormality, but seldom are born totally deaf.

The deaf child, although his vocal mechanism is normal, cannot learn to speak the way other children do since he hears no sounds to imitate; so, for the child without hearing, the greatest gift in life is speech. Without the ability to communicate with the hearing world, he faces a pitifully wasted life. Only through special educational methods can he learn to communicate orally with his fellow humans, to gain a useful education.

Today, through a special type of instruction provided by such schools as the Lexington School for the Deaf, New York City, can the deaf child learn to grow into a useful, productive individual.

"Because children rarely are born totally deaf," says Dr. Lee E. Connor, superintendent of Lexington School for the Deaf, "the first goal is to determine just how much a child can hear. We accept at the school only those who have lost more than 75 percent of their hearing."

There are numerous methods for determining the degree of hearing a child may have. The newest technique employs EEG audiometry, which computerizes information gained from picking up the youngster's electrical responses to sound. EEG-type electrodes are pasted on the scalp of a mildly sedated baby to monitor brain electrical activity before, during and after transmission of sound through earphones. The baby's responses, as recorded on the audiometer in varying decibels of sound, determine his degree of hearing.

Other tests also are used at the Lexington School, founded in 1867

as a small class in the home of a deaf little girl. Now, a century later and one of the oldest and largest private schools for the deaf in the country, Lexington has taught over 10,000 children of all races and religions to speak and read lips. Four-year-old Ken is a good example.

He was given a sectional toy and made to understand that he was to replace a piece of the sectional toy if he heard any sound. An audiologist rang a cowbell tuned to 1,000 cycles per second while checking the intensity of the tone on a sound-level meter. The test determines hearing loss at frequencies of from 200 cycles per second (the sound of a drum) to 4,000 (a baby's rattle). The results are recorded on a scale of decibels, or sound intensity units, ranging from 0 to 20 for normal hearing and from 20 to 75 for the hard of hearing.

When deafness begins

Deafness actually begins when a sound over 75 decibels—a moderate shout—cannot be heard. For Ken to hear, sound had to reach at least 95 decibels for his left ear and 107 decibels for his right ear. A hearing aid in his better ear—the left—did boost a few faint sounds to a more audible level. Once the degree of hearing impairment, or the level of decibels at which Ken could hear sound was determined, the next step was teaching him to hear and identify some 40 speech sounds of the English language. This involved hours of practice in breath control, mouthing vowels and studying the speech positions of a sponge rubber and plastic model tongue and palate, which revealed the parts of the mouth and throat used in speech, although not visible in a person. Practicing breath control by blowing on a feather, alternating long and short puffs, helped Ken overcome a tendency to inhale and exhale with each word spoken.

The next step was teaching him to speak words and associate them with objects and meaning. For example, a speech tutor pronounced the word "more" for Ken while he watched her lips and held his hand on her face to feel her jaw-muscle action. He had to comprehend the idea of putting together the two different speech sounds of "m" and "or". Once Ken learned to say "more" and understood its meaning, the tutor and his parents moved on to new words.

Through another technique, Ken "saw" how loudly he spoke the words he learned. He spoke the words into a decibeloscope, which operated a group of 12 light bulbs placed one above the other in an upright box. As Ken spoke, the bulbs lighted, and when he spoke loud enough to light the first nine bulbs he was using a normal conversational tone level. He heard what he said through an amplified feedback headset and gradually became accustomed to expressing himself in the conversational tone level.

Teaching a vocabulary to Ken, as with all deaf children, is a classroom task. The student's vocabu-

Education which was once unavailable to the deaf can now teach them to speak and to understand.

lary is built in a series of related words, each resting on a topical idea. The instructor builds carefully, introducing "robin" after "bird" has been learned and "blossom" after "bud". Each word is identified within the narrow confines of what deaf children can see, touch and smell, because it is important for them to identify and associate words with what they understand through their senses, other than hearing.

Once he completed all his training at Lexington, Ken's speech had a flat, robust quality as is common with most deaf children. Some of his companions had so much difficulty that their speech never did, nor never will, be understood except in one- or two-word snatches. But most students like Ken will be closer to the other extreme—the 25 percent whose speech will be distinctly understood. And those educated deaf will be able to converse with the world who hears because they have been taught to read lips of those with whom they converse.

Ken studied for 15 years at Lexington before graduating from high school. He built an imperfect but definitely functional storehouse of words which enabled him to read, write, understand and convey his thoughts to others through speech.

Fortunately, Ken was one of those students who, in aptitude tests, found a particular talent. He went on to Gallaudet College for the Deaf in Washington, D. C. Today Ken is making important contributions in a medical research library because Lexington School for the Deaf had the instructors, the understanding and teaching techniques to endow him with an education that was not always available to the deaf.

While there is progress in bringing new hope to the deaf, greater inroads have been made in remedying hearing impairments of the deafened.

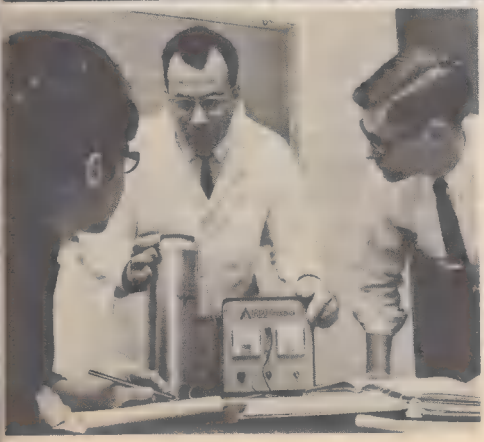
Intensive research

There is an intensive research program being conducted today to determine the cause of sensorineural loss. Since the inner ear cannot be examined during life, scientists must resort to the next best approach; examining inner ear structures after death. Such a procedure depends upon those living with hearing impairments bequeathing their temporal bones for study.

Medical research has made substantial inroads against many human ailments, some sensational in their ability to eliminate bacteria- and virus-caused diseases. Researchers investigating the causes of deafness are hopeful that studies of the inner ear may lead to developments that someday will bring nearly all the deaf out of their silent world.

NEW FOR PEOPLE

Battery-operated laser "gun" shoots beam of light visible up to four miles in daylight or dark. Scientists at Sperry Rand Corp., "gun" developer, say it could be used as signaling device by pilots downed behind enemy lines. Light appears to a rescue pilot as an intense flash of red. Is not harmful to eyes at distance of 10 feet.



Cryogenic educational kit being used by students in laboratory conducting an experiment with liquid nitrogen at a temperature of –320° F. Airco Cryogenics Division of Air Reduction Company, Inc., 225 Parkhurst St., Newark, N. J., provides equipment and instructions for studies in high school and college labs.

No more worry about your favorite photographs aging beyond recognition. Porcelain Art Photography Co., P.O. Box 91, Inwood Station, New York City, has developed a method to preserve photographs almost forever. Modern nuclear electronics and ultraviolet light exposure reproduce pictures under a porcelain glaze.

A Massachusetts Institute of Technology Brailler machine produces Braille at the rate of 190 English words a minute. Teletypewriter operator types information desired by Braille reader and the computer translates the information into Braille.

Picture yourself on the lecture platform with sufficient light to demonstrate your subject and you have a comprehensive idea of "Lecture Lite" developed by Instruments for Research and Industry, 108 Franklin Ave., Cheltenham, Pa. The light boxes come in a variety of sizes, illuminating various types of lecturing materials.

ASTRONOMY

Venus—a hellhole

Space probes are punching holes in the thick blanket of clouds that cover our sister planet. The picture they reveal is far from attractive.

You couldn't possibly live on Venus, and it isn't even a very nice place to visit. After studying the data transmitted back by the U.S. Mariner 5 Venus probe and the Soviet Venus 4 capsule that landed on the planet's surface, Dr. Von R. Eshleman, a Stanford University physicist, said that the planet was "not just like hell—it's like a hellhole."

In science fiction stories of a decade ago, Venus was commonly pictured as a place of steaming swamps, populated with prehistoric monsters. At the time, so little was known about the planet that the imagination of a writer could run wild. Venus is entirely shrouded in a layer of clouds, so that although it is closer than Mars, we really know very little about it.

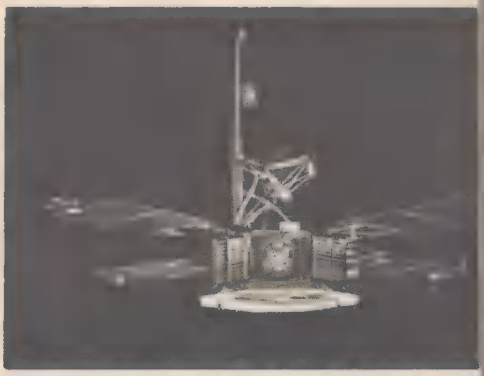
As space probes begin to give man a peek beneath the covering clouds, it turns out that the steaming swamp picture is far too flattering, at least as far as life is concerned.

Surface temperature may be 500° F or more, and the atmosphere is at least 15 times as dense as earth's. Such densities produce fantastic optical illusions and prompted Dr. Eshleman's description of the planet as a "hellhole." This sort of atmosphere would trap and bend light in such extreme ways that, according to Dr. Eshleman, "It would take a long time for people living on Venus—if there were any—to realize they were on a spherical planet. The horizon would always appear high, giving the person the impression that he was living in the bottom of a bowl."

A theoretical sunset on Venus would have the sun diffusing along the horizon, rather than actually setting. Night would still be illuminated by a distorted reflection of the sun as a glowing ribbon of light along the horizon. At sunrise—117 days later—the sun would reassemble in the west.

It would be possible—in theory—for a man standing on Venus to see the back of his own head. The dense atmosphere would have bent the light rays so much that the image had circled the planet.

The findings of the U.S. and Soviet probes make the possibility of life on Venus seem more remote than ever. But scientists were not willing to rule out the possibility entirely. William H. Pickering, director of Jet Propulsion Laboratories, advanced the possibility that



Above: Diagram of the flight of Mariner 5, which passed a scant 2,400 miles from Venus on Oct. 19. First successful probe of Venus was made by Mariner 2 in 1962.

Above right: Mariner 5, most recent in the series of space probes. Two and a half years ago a similar probe successfully sent back photos of the surface of Mars.

Right: The instrument package of the Soviet Venus 4 space probe with the heat insulation removed from the upper part. It was parachuted to the planet's surface.

there may be "low forms of life floating in the high altitudes or on extremely high mountains". Soviet scientist Nikolai A. Krasilnikov said that life forms similar to the heat resistant microbes found here on earth "theoretically could exist in the Venus atmosphere." Another Soviet scientist, Academician Mikhail M. Shemyakin, wrote in *Izvestia*, "Who will undertake to assert that we are insured against surprises? . . . More than once has the great master, Nature, sprung them on us."

In a really striking way, the atmosphere of Venus may resemble the atmosphere of the earth when it was young. The Soviet probe found that the atmosphere is composed almost entirely of carbon dioxide. Dr. Icchtiaque Rasool of the Institute for Space Studies of the National Aeronautics and Space Administration, pointed out that it has been calculated that early in earth's history there had also been a great deal of carbon dioxide in the atmosphere. Gradually however, it reacted with water to form carbonates and become chemically tied into the planet's rocks. In addition, this early atmosphere is thought to have had a surface pressure almost

identical to that found on Venus. Mars is also thought to have an atmosphere composed of at least 50 percent carbon dioxide.

The reasons for the differences between the atmospheres of Venus and earth are among the major questions opened by the new findings. Not that the carbon dioxide atmosphere had been entirely unsuspected. The Soviet findings provide what the *New York Times* has called, "spectacular confirmation of what must now, in retrospect, be judged one of the more brilliant feats of earth-based astronomy. Until 1932, astronomers tended to believe that earth and Venus had similar atmospheres, and much energy was expended in trying to find evidence for this view. In that year, however, W. S. Adams and T. Dunham of the Mount Wilson Observatory, found some unusual features in spectrum of radiation from Venus. Dunham then demonstrated that if light were sent through a long pipe containing compressed carbon dioxide similar spectrum peculiarities could be reproduced here on earth, indicating compressed carbon dioxide, had been observed in Venus's atmosphere. It is a landmark in the history of science that 35 years later that conjecture has now been dramatically and fully confirmed."

Discrepancies in the data reported back by the two probes have been noted. The most striking is that Mariner 5 detected a weak magnetic field around Venus, while the Soviet probe found no magnetic field around the planet at all.

The earth's magnetic field is thought to be generated largely by the movement of its liquid core and by the spinning of the planet. One theory is that Venus must have substantial molten core, and that this accounts for the planet's remarkable heat. Precise measurements of the magnetic field of Venus will help scientists determine the size of the molten core, but if a magnetic field does not exist, the puzzle of the heat of Venus remains as far from solution as ever.

Other findings were also puzzling. Mariner 5 detected what seems to be peculiar structures in the atmosphere of the planet. They may be due to storms or cloud layers, but at the present state of our knowledge, no obvious explanations exist.

One thing seems certain. Advance in knowledge about the planet Venus is likely to come from the Soviets, rather than from the U.S., over the next several years. The technically sophisticated landing on Venus demonstrates that the Soviets' lead in rocket power is still paying off for them. The extra power made a bigger payload and a more ambitious mission possible. The Russian Venus probe weighed four and a half times as much as Mariner 5. The Soviets seem deeply committed to an extensive program of exploring within the solar system.

Dr. William H. Pickering, director of Caltech's Jet Propulsion Laboratory, predicted that the Russians will probably attempt to land a capsule on Mars in 1969.

Science Month

Life three billion years ago

CHEMICAL substances that act as building blocks for the protein essential to all life have been detected in rocks that were formed while the earth was very young. The discovery of 22 amino acids in South African rock known to be at least 3.1 billion years old indicates the basic chemicals of life have not changed materially since life began.

The discovery by Dr. J. William Schopf, a Harvard University paleobotanist, marks the earliest occurrence of amino acids ever found and gains in significance from the fact that the earth is thought to be about 4.5 to 4.8 billion years old, while the oldest preserved rocks date back 3.5 to 3.8 billion years. Men evolved only about two million years ago.

The rock formation also contained fossils of algae and bacteria. Until the discovery of the amino acids, however, there was no real proof that these simple organisms had essentially the same chemical basis as they do now.

Dr. Schopf's search for primitive life on earth is connected with work at Ames Research Center, Mountain View, Calif., to develop methods for detecting life, if any, on other planets. For instance, amino acids would be considered one of the most valuable clues if life no longer existed on Mars—but once did—and scientists were able to find tell-tale traces such as components of proteins, the essential com-

This small, flower-like plant may be one of the world's oldest, says Dr. A. E. Porsild, retired chief of Ottawa's National Museum herbarium section. Seed of the Arctic lupines plant was found in rodent burrows 10 to 20 feet below the ground in the Yukon. Botanists believe it had lain dormant, but frozen, over 10,000 years. U.P.I.

ponents of all cells.

Dr. Keith Kvenvolden, an Ames research scientist in biochemistry, asserted that Dr. Schopf's discovery provided additional important evidence to support prevailing theories of the chemical evolution of life on earth.

New pain killer found

About three out of four cancer patients with intractible pain got relief after the administration of combinations of phenol and glycerin injected into the nerves. The effectiveness of the pain-killing agent in cancer patients was reported by Dr. Rita Goldman Jacobs of Memorial Sloan-Kettering Cancer Center, New York.

Dr. Jacobs told *Science Digest* that the ideal drug would be one that gave 100 percent permanent pain relief with no side effects. "We are pleased," she said, "with the results obtained with combinations of phenol and glycerin, which seem to be the most ideal pain-killing agents we've found so far. However, we shall continue our search for that ideal drug."

Permanent unrelenting pain connected with long term illnesses such as cancer usually is ended only by destroying the nerve fibers carrying pain sensations to the brain. This is achieved either by cutting the nerves or applying heat, cold, electrocautery, radio waves or X rays or by injecting chemicals into the nerve fiber.

Disclosure of the new pain-killing agents came in a report on a long-term search for drugs that can give relief from pain without causing side effects, and that can be used for long periods without losing their effectiveness or causing addiction.

Spinsters are smarter

There are apt to be some repercussions to a Washington sociologist's assertion that "Women are the 'cream of the crop' among unmarried persons of middle age, while bachelors are 'the bottom of the heap.' "

Statistics on single persons aged 45 to 54 show that the bachelors rank far below the spinsters in schooling and professional status, and even make less money, according to Dr. Jessie Bernard. She believes the tendency of men to marry slightly downward probably accounts for the differences among never-married men and women.

Dr. Bernard reasons that because men have tended to marry women of somewhat less education and standing than themselves, many well-trained and successful women have been bypassed as marital partners. It is this group, according to Dr. Bernard, that seems to account for the spinsters' statistical superiority. Conversely, thinks the sociologist, there are indications that

middle-aged bachelorhood may be related to low performance in school and on the job, factors that could make a man less desirable as a mate.

Getting down to statistics, they show that the men surveyed averaged nine years of school, compared with 12.4 for the women. Among the men, only 9.9 percent were in professional work, compared with 26.4 percent of the women. The men had a median annual income of $3,440 and the women $3,632.

Dr. Bernard is a retired Pennsylvania State University professor and mother of three children. She qualifies her findings by asking two questions:

1. Were the never-married men inferior because they never married, or was it the other way around?

2. Were the never-married women superior because they could dedicate their time and energies to their careers without the distractions of marriage?

Supereyes for astronomers

The biggest building boom in the history of astronomy is moving ahead to accommodate demands of astronomers for better telescopes and more of them to study the birth and death of stars and the origin of the universe. None of the new telescopic giants will equal in size the 200-inch Hale telescope atop Mt. Palomar in Southern California,

These stargazers at the University of Toledo's Ritter Observatory proudly flank their new 40-inch reflecting telescope.

but five of them will have light-collecting mirrors ranging in diameter from 144 to 158 inches, or about the size of portable swimming pools.

Three of the new giant stargazers will be in the Southern Hemisphere; two in Chile and one in New South Wales, Australia. Two others will be in the northern hemisphere; one at Kitt Peak National Observatory near Tucson, Ariz., and the other in British Columbia.

The five will not be in operation until the mid 1970s, but once operative they will give more astronomers an opportunity to study the heavens. Presently there are too few powerful telescopes to meet the demands of scientists who wish to delve into the mysteries of the stars and planets.

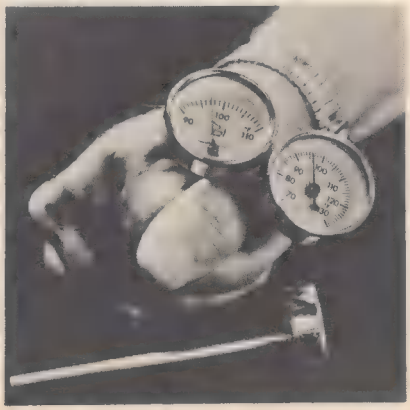
Meanwhile, additional telescopes

are being placed in operation. One was dedicated last October for the new Ritter Observatory at the University of Toledo. It's a product of Owens-Illinois, Inc. It's the first major telescope with a complete mirror system made from a new mirror material that promises to extend the accuracy of astronomical observations and the actual amount of usable observation time.

Thermometer for animals

The dairyman, rancher or farmer no longer need "shake down" a thermometer after taking an animal's temperature, thanks to the Lamb-Watts Biothermom, developed by Lamb Engineering Associates. The biothermom has a circular face the size of a half dollar, and is attached to a nonrusting metal which encloses a sensing coil that goes into the animal's mouth. The sensing coil construction makes it possible to record temperatures on the dial much faster than with a glass thermometer.

A new thermometer for animals needs no shaking down after being used.



"Billy the Bull" gets his temperature taken with the nonbreakable Biothermom.

The dial is easy to read, an important factor when taking the temperature of an animal in a dusty corral or a dark shed. Nonbreakable, the biothermom also enables the temperatures of a large number of animals to be taken quickly because of the rapid recording and fast reset mechanism of the new device.

Graphology: 'out' or 'in'?

Graphology or analyzing handwriting is finding growing favor among employers, although there are many in management who don't care a hoot about one's handwrit-

ing. Opposing opinions on the value of handwriting analysis may be quoted endlessly, but two from the *Wall Street Journal* indicate the spread.

"I won't touch a man who's applying for a sales position without having his handwriting analyzed," says Edward J. Nouri, head of a New York agency of New England Mutual Life Insurance Co. He says that a handwriting analysis can tell him more about what makes a man tick than he can learn from an interview or a whole battery of psychological tests.

George K. Bennett, president of Psychological Corp., a New York consulting firm, asserts, "The evidence to date is insufficient to show that graphology has any value in predicting personality, character, intelligence or any other trait. I wouldn't spend a plugged nickel on it."

Between these two extremes are executives who use graphology as an adjunct to psychoanalysis, aptitude tests and probing interviews.

A graphology will cost anywhere from $75 to $150 with a graphologist completing his analysis in from three to five hours. Graphologies generally are based on neatness and size of the handwriting, slant and intricacy of the letters and the way letters are connected to form words.

A person who writes with long, sharply angled upstrikes on tall letters is judged by a graphologist to be defiant and self-assertive. Precise, regular spacing between letters and words indicates a systematic, careful and somewhat unadventurous mentality, according to graphologists.

Porpoises with their own baby-sitters? It's true, says the National Geographic Society. When a porpoise is about to give birth, she whistles and another female swims to help. Following the baby's appearance, the mother's friend helps guard the infant. And her friend babysits while the mother goes off to feed.

So well insulated are two cryogenic fuel tanks on the Apollo spacecraft that ice cubes placed inside them would take eight and a half years to melt.

Man's ability to outmaneuver animals is demonstrated by Japanese fishermen who use large clay jars to capture octopuses for food. National Geographic Society says that the many-armed mollusks, loving dark crannies, crawl inside and, not suspecting danger, let themselves be hauled gently to the surface.

A man with 20-20 vision would be said to have excellent sight, but a golden eagle can see eight times better than man. The National Geographic Society says a mature bird can spot a rabbit half a mile away. In fact, the eagle's sight is telescopic, microscopic, monocular and binocular.

The search for the remains of a Grecian city inundated by an earthquake around 550 A.D. led to the discovery of this Ancient idol of white marble dating back to 2500 B.C., and a veritable treasure of pottery, like that shown here.

Rescuing sunken history

by William and Ellen Hartley

DURING the past summer a 40-foot boat loaded with diving gear anchored in the Mediterranean south of Greece. The nearest land was Antikythera, a tiny, sparsely-populated island midway between Peloponnesus and the northwestern corner of Crete.

On deck, a small party of Greeks and Americans watched anxiously as Dr. John E. Hall adjusted his underwater breathing apparatus, slipped into the sea and dropped from sight. Dr. Hall, 42, a diver-archaeologist, classical scholar and associate professor of humanities at the University of Miami, Florida, would be diving 180 or more feet to the bottom of the Mediterranean. There, with luck, he hoped to per-

form the first operations toward opening a new chapter in the history of underwater archaeology.

The story begins in 1900, when a sponge diver broke surface with a bronze replica of a human arm hitched to his lift line and a story that the bottom was covered with partially buried bronze and marble statues. The boat captain checked his diver's story and later made an arrangement with Greek authorities to assist in a salvage operation. According to modern authorities, this was the first underwater archaeological expedition.

But much of the material was never recovered. One problem was that uneducated sponge divers could not discriminate between valuable and worthless objects, and archaeologists sent out from Athens were not trained to dive.

Today the situation is much different. Many archaeologists, including Dr. Hall, are learning to dive as well as to dig.

Dr. Hall describes today's situation in these words: "The divers kept complaining that pieces of statues were under huge rocks, so the archaeologists on the surface would tell them to get the rocks out of the way—haul them to deeper water and dump them.

"On just about the last day, one archaeologist said, 'It doesn't make much sense for rocks to be on top of the cargo. Let me take a look at one.' So they hauled one up. It was half of a marble statue. We believe 27 of these statues were taken from the wreck in ignorance and hauled to much deeper water."

These were the objects for which Dr. Hall and his party were searching last summer. His expedition was authorized by the Greek government and under its direction.

Unable to locate the statuary, the expedition worked up the western Greek coast to a location that cannot as yet be disclosed. Here they discovered an astonishing pocket of artifacts that may prove to be one of the most important finds of recent years. Dr. Spyridon Marinatos, director of the Greek Ministry of Archaeology, is now evaluating Dr. Hall's survey information. As soon as the Greek government has released an account in Greek archaeological journals, details can be disclosed.

Underwater archaeology, frustrating or rewarding, is a relatively new science that owes its existence primarily to the development of the aqualung in 1942 by Jacques Cousteau and Emile Gagnan.

Moreover, archaeological studies beneath the water are tremendously important to our understanding of man's history. Although water damages some ancient objects, it also preserves many that would have disintegrated or worn away under other conditions. Thus a mass of revealing history lies beneath the seas, particularly in the Mediterranean, but also in other parts of the world.

In general, there are four basic kinds of underwater archaeological sites. Wrecked ships, with artifacts preserved by mud, sand or coral;

sacred wells or cenotes in which ancient people threw religious offerings; primitive trash heaps in waterfront areas; lost cities beneath the water.

Of these, the most significant in recent years have been the shipwreck sites and the sunken cities.

Of the sunken cities, two of the most fascinating are Pheia (pronounced "Fee-Ah"), on the northwest coast of the Peloponnesus near Katakalon, and Port Royal, on the southeast coast of Jamaica in the Caribbean. Although widely separated geographically and in time of disaster, both cities were inundated as a result of earthquakes—Pheia at about 550 A.D. and Port Royal on June 7, 1692.

Pheia is mentioned in the *Iliad* and *Odyssey*, since it was the port city of ancient Elis where sacred Olympia was located. Apparently Pheia was in existence from as early as 1600 B.C. until a day in the mid 5th century A.D., when an earthquake slid most of it into the Ionian Sea. Thereafter, until just 10 years ago, it was only a mystifying reference in the writings of Homer and other ancients.

But in 1957 Dr. Nicholas Gialouris, then curator of the Olympia Museum, heard an exciting story. Two Greek fishermen had spotted part of an Ionic column in a bay three miles south of Katakalon. Although he had no SCUBA equipment at the time, Dr. Gialouris spent four days at the site with some Greek divers and found numerous column sections and building stones, the usual broken amphorae (wine, water or oil jugs) and the distinct trace of a wall.

Moreover, other wall stones and city-associated artifacts were found on an acropolis hill by the bay. The wall could have been the very one near which King Nestor once fought. But proof that Pheia had really been found would have to wait until 1960. In that year, a well-organized expedition equipped with SCUBA gear studied the site. One member was Dr. Hall.

Gloria and John Hall, Dr. Gialouris and several other archaeological authorities established a base camp on the shore of the bay. In a procedure somewhat typical of archeologists, they carefully sheltered the diving equipment in a house, while they themselves lived outdoors! Gloria Hall had learned to dive, and she also served as cook and bookkeeper. A skilled artist, she proved invaluable as expedition cartographer.

It was apparent almost at once that the ruins beneath the bay, covered by water ranging from shallows to 40 feet in depth, could only be those of the Homeric city of Pheia. Some 250 feet of city wall was discovered, along with numerous columns, capitals, bases and building blocks. The expedition decided to leave the large objects in place, clean them, mark them with floats and map the entire area.

This was tough work. Dr. Hall says, "Once you find your city, you spend hours scraping seaweed. We also found hundreds of broken or

Beneath the bay three miles south of Katakalon, archaeologists found remains of the city of Pheia, including an Ionic capital and base and a corner stone of a pediment, all shown here. These ruins were discovered by the divers 40 feet underwater.

whole amphorae, most of them with at least one octopus living inside. So you'd pull up the amphora and wait for the octopuses to depart."

These creatures were a source of worry. They have beaks like a parrot and a somewhat poisonous bite. Shortly before the Halls' arrival in Greece, a man had died after being bitten on the neck by an octopus.

A number of valuable finds were made at the Pheia site. One was a stone anchor of apparently pre-Hellenic origin. Another was a Cycladic statue or idol dating back to 2500 B.C. This is a puzzler, for it would seem to pre-date Pheia. Hall theorizes that it may have been an antique in some Greek household.

But the greatest discovery at Pheia was Pheia itself. It's the first underwater city ever discovered and explored with appropriate archaeological techniques. It's also the oldest. Moreover, there's a plan, already started, to maintain it as a permanent underwater museum—a kind of underwater Pompeii.

Other sunken cities remain to be found in the Mediterranean. Hall looked for one south of Pheia this summer after conducting his dangerous dives off Antikythera. He believes he missed it by half a mile.

During 1966, Dr. N. C. Flem-

Hundreds of broken or whole amphorae, like these pieces rescued from the deep, were found as part of the ruins of Pheia. Most of these Greek jars and vases were found to contain at least one living octopus inside. Divers had to take care to rid the ancient pottery of its inhabitants before pulling it up, for the creatures disliked being disturbed and put up resistance.

ming, with a group from Cambridge University, explored 18 sites of sunken cities along the coasts of Libya and Tunisia. These were Phoenician colonies of the 9th and 8th centuries B.C. In a report at the Third Conference on Underwater Archaeology, held in Miami, Fla., last March under joint sponsorship of the University of Miami and the Council on Underwater Archaeology, Dr. Flemming described a North African mole or breakwater more than 1,000 yards long and 300 feet wide, with stones as large as an automobile—probably the largest Roman breakwater ever discovered. Dr. Flemming's finds indicate lost cities, sunk beneath the waters, to be explored at a convenient time.

A second sunken city

The sunken city of Port Royal on the Jamaica coast is as interesting for its known history as Pheia is for its great antiquity. Before its destruction, Port Royal was a pirate stronghold, "the wickedest city on earth," where Henry Morgan hung out and other "gentlemen of the account" drank, gambled and wenched away their plunder.

A few minutes before noon on June 7, 1692, Port Royal was shaken violently by three earth tremors. In about two minutes, the entire waterfront section had slid into the sea. More than 2,000 persons were drowned or crushed, and the boiling waters, smashing back at the disaster area, swept over all but a third of the town.

In 1956, Edwin Link and a party in his first *Sea Diver* ship visited the site, and they returned in 1959 for two months of exploration in a new *Sea Diver*. A preliminary survey was made, and numerous artifacts were brought to the surface—hundreds of bottles, tools, kitchenware and even a fine brass watch with only the hands missing.

Edwin Link's wife, Marion, described this find vividly in *The National Geographic Magazine* (February 1960).

In the past few years, Port Royal studies have been carried on under the direction of Robert P. Marx, an American archaeologist, with sponsorship of the Institute of Jamaica. Plagued by silt from nearby dredging, Marx and his divers have still managed to recover additional bottles, pewter utensils, clay pipes, weapons, etc. From these objects, it's possible to tell what was sold in the stores of Port Royal and how people lived there 275 years ago.

The greatest shipwreck studies of recent years have been conducted in Aegean and Mediterranean waters along the southwest coast of Turkey, particularly near Cape Gelidonya and in the reef area near Yassi Ada. These wrecks are tremendously older than the Swedish warship *Vasa* (1628) that was raised successfully in 1961.

Peter Throckmorton, a New York photographer and diver interested in archaeology, has been directly responsible for several discoveries along the Turkish coast. In 1958, he sailed out of Bodrum with Capt.

Remains of Byzantine ships of the 6th and 7th centuries were found on Turkish coast.

Kemal Aras, a Turkish sponge diver, to look for wrecks in the shoal waters of Yassi Ada (Flat Island). Here ancient ships, squeezing between mainland and the island of Kalimnos, had gone down in startling abundance.

Throckmorton and his Turkish friends tried to camp on Yassi Ada but were driven off by rats. They were fortunate, however, in spotting some 15 wrecks along the Turkish coast. Two, lying in 120 feet of water near Yassi Ada, turned out to be Byzantine ships of the 6th or 7th century.

After the initial survey, the American heard an odd story. While diving at a location down the coast near Cape Gelidonya, Capt. Aras had found some bronze objects in about 90 feet of water. They seemed to be flat pieces of metal crusted together.

From a description of their appearance, Throckmorton decided they sounded like pieces of bronze tribute depicted in Egyptian tombs of about 1500 B.C. An Aegean Bronze Age people had given these objects to the Pharaohs.

He was back the following year with Drayton Cochran, Cochran's son John, a Florida girl named Susan Phipps and a number of divers and archaeologists. After training briefly on the Yassi Ada wrecks, the party headed for Cape Gelidonya.

Here they found terrible currents that could sweep divers off their feet for hundreds of yards—but no wreck. They were about ready to give up when John Cochran and Miss Phipps, making a final dive, came up with several bronze spear points and a thrilling report that they had seen the oxhide-shaped bronze ingots. Despite violent weather that shattered plans for a longer stay, the Cochran party was able to bring up some tools, weapons and pottery. Authorities later dated these objects and the wreck at 1200 B.C.

George Bass now enters the picture. Bass, author of *Archaeology Under Water* (Praeger, 1966), is an archaeologist associated with the University of Pennsylvania Museum. Throckmorton's discovery inspired a 1960 expedition, sponsored by the museum and the Council on Underwater Archaeology, to explore the 3,000-year-old wreck carefully. Frederic Dumas would be chief diver; Throckmorton would provide invaluable guidance; and other members included Bass, as expedition leader, and his attractive wife, Ann.

The currents off Cape Gelidonya were as terrible as they had been the previous year. (One problem with wrecked ships is that they obviously sank in dangerous waters). But the divers, sometimes scissoring their legs around objects

to keep from being swept away, performed the incredible task of raising the cargo in huge sections. This was like hammering out the parts of a jigsaw puzzle on the bottom, raising the masses with an hydraulic jack, getting them to the surface with hoists or lifting balloons and then putting the puzzle together again.

They also solved a classical mystery. Homer had mentioned brushwood as being used in the vessel built by Odysseus, but no one had understood exactly how or why it was used. The Phoenician wreck at Gelidonya revealed that it had served as dunnage to keep cargo from shifting or chafing.

With this tremendous job completed, Bass and some 15 experts turned, in 1961, to an examination of one of Throckmorton's Byzantine ships near Yassi Ada. The National Geographic Society and the University of Pennsylvania Museum supported the study—probably the most exacting ever undertaken. The plan was to perform a total recovery and, through measurement of every available timber or fragment, draw up an exact reconstruction of a ship that had sunk around 620 A.D.

The Byzantine ship had gone down in 120 feet. Bass decided to live on mainland and operate from a barge above the wreck.

During 1961 they cleaned and plotted the wreck carefully. Most of the cabin area was exposed and the timbers were pinned in place with pointed bicycle spokes. A great amount of amphorae and Byzantine pottery was recovered, along with some 16 gold coins minted in the reign of Heraclius (610-641 A.D.). Oddly, the party even learned the name of the ship's captain. He had conveniently stamped it on the end of a weighing device—*George Senior Sea Captain*.

By the end of 1962, much of the ship's wood had been exposed and Frederick van Doorninck Jr., a graduate student at the University of Pennsylvania, was able to begin reconstruction drawings. This demanding job has been called one of the most significant of all recent contributions to the history of naval architecture.

Yassi Ada revisited

In 1963 the party camped on Yassi Ada after screening the location against rats. This was necessary to increase the pace of the work and to provide a means of saving the ship's delicate timbers. Using a basket 18 feet long, the divers would fill it with wooden members and fragments at the 120-foot depth. Then, in a delicate and somewhat dangerous maneuver, they literally walked the basket 100 yards to the shore of Yassi Ada, where the contents could be kept in water until protected with preservatives.

The continuation of work at Yassi Ada and other sites—some not mentioned here because exploration is just beginning—promises to fill great gaps in our knowledge.

Australian News and Information Bureau

Although it hardly looks like a force capable of threatening the existence of Australia's Great Barrier Reef, the Crown of Thorns Starfish is doing just that. The thorny creatures of the sea are progressively eating their way through the many miles of coral reefs.

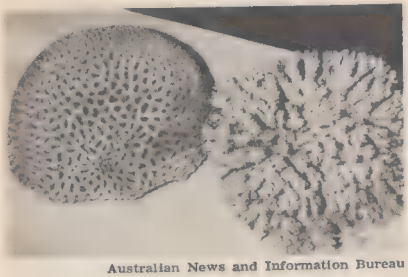
End of the Great Barrier Reef?

PICTURE thousands of sea creatures, each of which is up to two feet in diameter and has 16 arms, devouring all in their path. It sounds like a scene out of a James Bond thriller or a monster movie, but it's not. The creatures are Crown of Thorns Starfish, and what happens to be in their path right now is Australia's Great Barrier Reef.

The starfish have appeared in plague proportions at the northern end of the Reef over the past several years, and they are systematically eating their way through Australia's most valuable tourist attraction. At their present rate of destruction, the starfish could kill up to 90 percent of living coral within just a few years.

Several reefs have already been devastated by the starfish with the voracious appetite. It is no wonder, then, that as they march steadily onward, scientists are becoming increasingly alarmed for the future of the Reef. Scientists know how and why the Crown of Thorns Starfish eat coral, but they have no idea of the extent of the plague or the direction in which it is likely to spread. A Belgian scientific expedition will attempt to solve the puzzle.

"Once we know precisely where



Australian News and Information Bureau

Two of the varieties of coral that make up 1,250-mile Reef—and starfish's menu.

Australian News and Information Bureau

Triton shellfish, natural predators of the starfish, may be only hope for saving Reef.

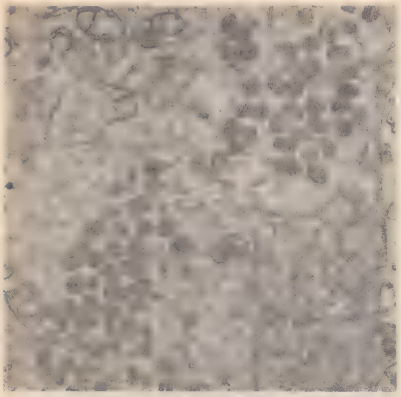
the starfish are and where they're going, we can do something about it; and we have got to do it soon," says Dr. Robert Endean, reader in zoology at the University of Queensland and a world authority on marine toxins. He explained that quick-lime will stop the starfish, but it is only a localized and unwieldly control method. The real solution undoubtedly will come through what is believed to be the starfish's natural predator, the triton shellfish.

Starfish are prevalent only where the triton is scarce, particularly in the islands and reefs closest to the areas of population. Once the reef is mapped for starfish, the next move would be to seek fauna protection for the triton and then force-migrate large quantities of them to where the starfish are prevalent. This would result in the triton devouring the starfish and hopefully end the threat starfish pose to Australia's Great Barrier Reef. Beyond this possibility there is another important phase to the Belgian expedition.

A concentrated hunt will be made for the sea wasp, a long tentacled jellyfish. Dr. Endean and a number of biologists in recent years have made spectacular progress in isolating the sea wasp toxin, discovering the jellyfish's poison offers a variety of possible medical uses. However, the first step is locating the breeding grounds or winter hideaway of the elusive jellyfish, which vanishes for six months of the year. Then, as the water temperature rises, it suddenly reappears.

Still another probable benefit of the Belgian expedition may be discovery of new prawning and scallop grounds. Such an eventuality stems from the expedition's series of methodical dredging projects in the areas between the coral reefs. Previously, prawners have steered clear of the reefs, fearful of shredding their nets on the coral.

The expedition is financed by the Belgian Ministry of Education, the National Foundation for Scientific Research, the University of Liege, the National History Museum and other Belgian universities.



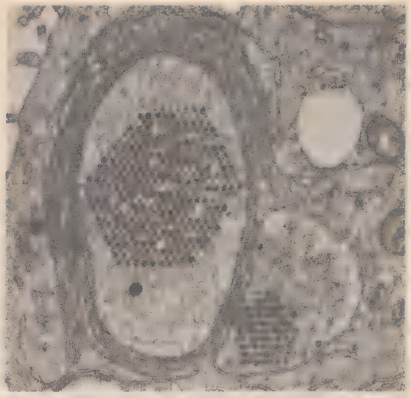


Photo: Dept. of Microbiology, College of Physicians & Surgeons, Columbia University

Vaccinia virus, left, and Adenovirus, right, magnified thousands of times here, are live viruses used in vaccinations or in tests. Both have produced some undesired effects.

Live virus vaccines—benefactors with a catch

No one denies that live viral vaccines have saved millions of lives and prevented other millions of people from being crippled for life. For public health, they have provided a control of disease unattainable otherwise. But there is another side of the story. Medical scientists do not know, in many instances, the long range—and sometimes immediate—effects that immunizing live viral vaccines will have on human cells. In a few cases, unusual effects are beginning to show up and suspicions are growing. Most distressing is the possibility that live viral vaccines may change the structure of living cells, including the hereditary material that is the fountainhead of life.

The author of this article, Dr. Richard DeLong, is an associate professor of biology at the University of Toledo. His research in the viral approach to human leukemia has revealed to him clues that impel him to sound an alarm. The views expressed in this article are his, based on his own studies, and represent one side of a subject vital to all.—Ed.

Richard DeLong, Ph.D.

SINCE we seem to be hurtling toward mass vaccination of the human population with live viral vaccines, the time is approaching when everyone should be made aware of the possible hazards involved in their indiscriminate use.

Usually, viruses are defined as

"replicating nucleoprotein macromolecules" that reproduce only within living cells. Nucleoprotein macromolecules are large molecules composed mainly of protein and nucleic acid. The nucleic acid is the hereditary material and this substance can reproduce itself in living cells. Viruses are molecular in size and can pass through most membranes very easily. They are intracellular parasites, limited for survival to this single life condition. When they infect, they maintain and reproduce themselves within living cells. Viruses are so intimately associated with the cells they infect that many times they incorporate their hereditary material into the hereditary apparatus of the cells.

Viruses "pluripotential"

Another characteristic of viruses is that they are "pluripotential," which means that they have the ability to manifest themselves in different ways, depending on environmental and cellular conditions.

Viruses have the ability to infect cells in two ways. One type of viral infection is called active; the other, latent. In active infection, viruses enter a cell and begin reproducing almost immediately. The new viruses are released from the cell and can infect others.

In latent infection, viruses enter a cell but do not begin reproducing immediately. Instead they apparently attach their hereditary material to that of the host cell's hereditary material. When the infected cell reproduces, so does the virus. In this manner, each cell formed from a virally-infected cell contains the hereditary material of the infecting virus. An appropriate stimulation from the environment causes the latent virus in the cell to become active, and it starts reproducing newly-formed viruses which are eliminated from the cell. All the stimuli which might induce a latent virus to become active are not known; some that are: radiation, heat, cold, certain chemicals.

Both active and latent viruses can act upon cells in different ways. There are at least three possible results when cells become infected with viruses—death of the cells, accelerated reproduction of the cells or no apparent effect. Cells which exhibit no apparent effect may be affected, however. There may be chromosomal defects or even more subtle defects which could be inherited by succeeding generations of cells. Chromosomes carry the genes or hereditary units, and any change in one or more of these units is inherited by the cell's offspring.

Viruses can be transmitted from generation to generation through the sperm or egg, the placenta and maternal milk.

Viruses used in live vaccines are no exception in all this.

Vaccines may be classified as of two types—live or killed. A live vaccine contains infectious viruses, though most of them are "attenuated," which means they have been changed to weaken or abolish their virulence for a particular disease.

A killed viral vaccine contains non-infectious viruses. Both confer protection on a vaccinated individual. However, the live viral vaccine stimulates the production of antibodies in humans causing a genuine viral infection in the individual. The killed vaccine stimulates antibody production without infection.

Some of the more important potential hazards of using live viral vaccines include the following: (1) damage or death to developing embryos, (2) possible cancer production, (3) possible initiation of new diseases, (4) possible genetic defects, (5) presence in the vaccines of "passenger" viruses which may be harmful.

It is well-known that some viruses can cause death or damage to developing human embryos if the mother becomes infected during pregnancy. The rubella virus is a classic example. This virus causes the "three-day measles" in postnatal life. In the developing embryo, it can cause abortion, death or many abnormalities. Some defects it has been known to cause include microcephaly (pin-headed idiocy), bone defects, deafness,

"Passenger" virus in action

Last November, federal authorities stopped the release of Sabin oral polio vaccine made since the previous July because green monkeys used in the manufacture of the vaccine in West Germany were identified as the source of "disease agents" apparently dangerous to man. Dr. Wilbur Downs, director of Yale University's Arbo-virus Research Unit, is quoted by *Medical World News* as saying, "Nothing like (the disease) has ever been seen before. It appears to be among the most dangerous agents known to man."

Investigators are trying to trace the whereabouts of 2,000 green monkeys used in making the U.S. embargoed lots of oral polio vaccine. Green monkeys from Uganda were identified as the source of the mysterious illness that struck 30 persons in West Germany, killing seven of them. Most of the Germans afflicted were laboratory technicans involved in obtaining monkey kidney tissue for culturing the polio vaccine viruses.

A spokesman for the division of biological standards of the National Institutes of Health, Bethesda, Md., confirmed reports that the embargo had been placed on the Sabin vaccine produced since last July. The agency added that supplies of the vaccine produced prior to July were in sufficient supply to meet all demands. The agency added that none of the green monkeys brought into the U.S. were from Uganda and the animals were in quarantine several weeks longer than the four-to-nine day incubation period for the so-called green monkey fever.

blindness, heart defects, dental abnormalities and many others. Vaccinia virus, the live virus used in vaccinating for smallpox, has been known to cause abnormalities or death in human embryos when the mother had been vaccinated during pregnancy. Recently, it has been found that the attenuated type II poliovirus (used in the Sabin live poliomyelitis vaccine) causes injury and death to cultured human embryonic cells.[1,2] The possibility exists then that viruses used in live viral vaccines could infect and affect embryos.

Cancer in animals

It is now established that certain viruses have the ability to cause cancer in some animals. As yet, no absolute proof has been found that viruses can cause human cancer, but evidence is accumulating that some viruses may. If this should be found to be true, then infectious viruses used in vaccines might also possess cancer-inducing properties. Live adenovirus vaccines are being developed for human vaccination. Adenovirus, type 12, a human respiratory virus now being used experimentally in vaccines for some respiratory ills (not flu), is known to cause cancer when injected into laboratory animals.

Viruses in live vaccines often are changed so that they will no longer cause the particular disease against which they are being used. During this changing process, however, the viruses may be changed in other ways. It is possible that these changes might, in some viruses, cause entirely new diseases in humans. Perhaps the most insidious unknown factor in the live viral vaccine picture, however, lies in the field of genetics.

Genetic defects are inherited. Viral infection can cause many genic and chromosomal changes in cells. If the germinal cells of humans became infected by viruses, they could cause genetic abnormalities in the sex cells of humans. Any defective sperm or egg would transfer its defects to the offspring. Viruses are known to cause chromosomal breaks, deletions, pulverizations, inversions and abnormal chromosomal numbers in cells. Any of these occurring in a sperm or egg could cause abnormalities in succeeding generations. The viruses used in live measles viral vaccine cause many chromosomal abnormalities in human cells. These have been found both in cells taken from vaccinated humans and from human cells in culture which were infected with the measles viruses used in the live measles vaccine.[3] Similarly, attenuated type II poliovirus, which is used in the live poliomyelitis vaccine, has been found to cause chromosomal abnormalities in cultured human cells.

The effects of live viral vaccines for any of the above mentioned potential hazards are seldom thoroughly tested. The United States Public Health Service does not require testing for any of these possible dangers.[4]

"Passenger viruses" are sometimes found in cells being used to cultivate viruses for vaccines.

The production of live viral vaccines requires a living cell system. It is possible that the cells used to cultivate viruses for vaccines may be infected already with viruses. These viruses are called "passenger viruses." Passenger viruses might be harmful to humans. The live poliomyelitis vaccine had been administered to many millions of people before it was discovered that the vaccine also contained a virus which was present in the monkey kidney cells that were used to cultivate the polio viruses for the vaccine. Since then, this virus, called Simian virus 40, has been found to produce cancer in laboratory animals, cause chromosomal abnormalities in cultured human cells and cause cultured human cells to be transformed to malignant cells.[5] So far such phenomena have not been observed in the human body—but that doesn't mean it can't happen.

A live mumps vaccine, which is in the experimental stage now but will be introduced on the market should human trials prove it effective in preventing mumps, is made by using live chicken cells. Chicken cells serve as hosts for the leukosis viruses. These viruses cause various forms of malignant diseases in chickens such as sarcoma, leukemia and osteopetrosis. So far, no proof exists that the same viruses can cause the same diseases in humans, but they are beginning to be suspected. The leukosis viruses are extremely common inhabitants of chicken cells and may be carried in chicken cells in the latent state.

Recently, Dr. Philip A. Brunell of New York University School of Medicine said there was some difference of opinion over duration of protection of the live virus mumps vaccine developed by a research team led by Dr. Maurice R. Hilleman of Merck Institute of Therapeutic Research. Dr. Brunell pointed out that natural mumps infection is believed to give nearly lifelong protection. If children receive a vaccine giving immunity for only several years, they might be susceptible again in young adulthood, when the illness can be most severe. The vaccine is expected to be on the market shortly after the first of the year.

It would be very difficult, if not impossible, to detect with certainty the presence of all latent viruses in cells. The live measles vaccine was made by cultivating the measles virus in chicken and dog kidney cells. It is known that many animal viruses can be transmitted to humans and cause diseases in humans. It behooves us then not to take chances concerning the possibility of transferring passenger viruses to humans through vaccination. Before the discovery of passenger viruses in the live poliomyelitis vaccine, no tests had been

made for these viruses in the production of live viral vaccines.

None of these dangers exist in killed viral vaccines. The rush to produce human vaccines containing live viruses is distressing to many virologists (there are many live viral vaccines in the experimental stage at the present time). A live viral vaccine should be used *only* if no effective killed viral vaccine can be developed. However, this has not been the case. Rather, live viral vaccines are being publicized and advocated for use over that of proven effective killed viral vaccines. Examples are the live Sabin poliomyelitis vaccine over that of the killed Salk poliomyelitis vaccine and the live measles vaccine over that of the killed measles vaccine. Instead of developing more live viral vaccines, efforts could and should — in the opinion of most thoughtful virologists—be applied to developing effective killed viral vaccines and administering these for vaccination.

It takes no genius to realize the far-reaching effects that these potential hazards could have on mankind should they exist, and *it has not been shown that they do not exist.* Perhaps mankind has been lucky, and the live vaccines administered already will not produce any ill effects in the human population. I hope so sincerely. Yet, this cannot be assumed since many of the effects of such vaccines may not appear for some time. Cancer and genetic defects, for example, may take years to appear. Some, such as birth defects, might have occurred already, and this should be investigated. The course that should be taken now is to stop introducing new live viral vaccines without adequate testing.

I am not against vaccination. In fact, I am one of the strongest advocates of vaccination and preventive medicine. My plea is simple—do not use live viral vaccines when effective killed vaccines are available.

The scientific and medical community, as a whole, and especially virologists, immunologists, geneticists, embryologists, cancer researchers, physicians and public health workers should be greatly concerned about live viral vaccination.

The public—largely uninformed on this subject to date—must be protected against unsafe or questionable vaccines. My appeal is to scientists and the medical profession to question the safety of live viral vaccination until they are utterly satisfied that no harm can come to mankind through its use.

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[1]Bablanian, R., Eggers, H., Tamm, I. *Virology,* 1965, 26, 100-113.
[2]Bablanian, R., Eggers, H., Tamm, I. *Virology,* 1965, 26, 114-121.
[3]Nichols, W. *Am. J. of Human Gen.,* 1966, 18, 81-92.
[4]United States Public Health Service, Regulations, Biological Products, title 42, Part 73, Publication No. 437, Oct. 1, 1965.
[5]Wallace, R., Moyer, A. *Proc. Soc. Exp. Biol. Med.,* 1965, 119, 481-486.

Farmers in rural sections of this country carry out the never-ending search for underground water by an old method which originated in Europe—water witching. At left, an instrument of wire is used; at right, the most common tool, the forked twig, is used.

Psychologists examine the "secrets" of water witching

by Ray Hyman and Evon Z. Vogt

TODAY'S farmers, who employ the latest findings to help them in selecting seed and fertilizers and in fighting plant diseases, nevertheless turn to ancient divining practices when they seek underground water. A closer look at water witching may tell us something about the

perseverance of non-scientific beliefs within our culture as an example of a more general phenomenon —the way people try to cope with uncertain and unpredictable environments.

Many aspects of water witching indicate that its role in our society is similar to that of magical ritual in primitive societies. Water witching, like magic, has an immediate practical aim; like magic, it is carried out only by those who have "the gift"; it is performed according to an unchanging ritual; it is accompanied by a mythology (about the distribution of underground water); and its mythology supplies ready rationales for apparent failures.

A magical ritual

The study of water witching as a form of magical ritual also offers the opportunity to evaluate a widely accepted but seldom-tested anthropological theory about the function of magic. As stated by the anthropologist, Bronislaw Malinowski, this theory holds that "man resorts to magic only where chance and circumstances are not fully controlled by knowledge."

If Malinowski's theory about the function of magic applies to water witching, we should expect to find a correlation between the prevalence of water witching and the degree of uncertainty and risk that accompany the locating of underground water. From this we can derive a hypothesis and counter-hypothesis to test Malinowski's theory: We would expect to find that witching is common wherever the outcome of well-digging is highly uncertain. On the other hand, we would *not* expect water witching to be practiced where groundwater conditions and geological knowledge make the outcome highly predictable.

We therefore carried out a large-scale study whose primary objective was to gather information that would confirm or contradict the hypothesis.

It appears that there are approximately 18 witches per 100,000 population, or a total of 25,000 water witches in the country. A further breakdown reveals that there are about 35 witches per 100,000 population in predominantly rural areas and only eight witches per 100,000 in urban areas.

The percentage of witches is highest in the groundwater regions where groundwater problems are most severe, and is lowest in the regions where there is an ample supply of underground water.

The findings confirmed our original hypothesis, and they are consistent with the theory that magic serves an important function, and with the view that witching is a ritual that reduces anxiety in the same way that magic does in nonliterate societies.

The variations from standard practice to be found in America, usually involving the shape of the rod or the material used, are all of

Based on a copyrighted article in *Psychology Today*, published by CRM, Inc.

According to folklore of water witching, diviners are among the "gifted" who are born—not made.

European origin, and are described in the earliest accounts. Even "long distance" witching above a map as practiced by the famous American diviner, Henry Gross, is a European importation. The only distinctively American contribution is the term, "water witching." In England it is called "dowsing;" in the Latin countries, "divining;" and in Germany, "wishing" or "striking." The quasi-scientific terms which are widely used in Europe—"radiesthesia," "dryptesthesia" or "rhabdomancy"—are apparently unkown to the American farmer.

From the 16th century until today, the diviner's trademark has been the forked twig or branch. Our data revealed that the forked twig is still by far the most frequently used instrument of American diviners. But even in the 16th century there were variations. Instead of hazel, ash or pitch-pine twig, the rod might be of iron or steel; indeed it appears that any rod-like object, forked or not, can serve; walking sticks, surgical scissors, a stalk of grass and even a German sausage have been pressed into service as divining rods.

In arid regions where trees are scarce, wire is used—baling wire, barbed wire from the nearest fence and coat hangers—or metal tools such as welding rods, tire irons, crow bars, steel files or pliers. But almost anything will serve in the never-ending quest for water.

The folklore of water witching suggests that witches are born, not made. The most frequently-recurring statements contain the belief that the "power" is inherited—"from father to son or daughter," "from mother to daughter," "to one person in a family," or even "to the seventh son of a seventh son." A related belief is that only certain people can be witches; "If you have the gift, you can do it."

Among academic skeptics, water witching is apt to be dismissed as being practiced only by the uneducated, and at first sight our data seemed to bear this out, for in about 66 percent of the counties with diviners, it was reported that the average diviner has only a grade-school education or less. But the exceptions are impressive. As many as 30 percent of the counties in our sample reported that the average diviner has a high-school education, and no fewer than three percent reported diviners who had received a college education. When we consider that the need for witching occurs mainly in rural areas, and that rural areas as a whole have lower educational levels, it is evident that the witch, by and large, is as well educated as the average man in his community.

In the overwhelming majority of cases, witching is not practiced as a livelihood. Of the approximately

25,000 witches in the United States, probably only a handful try to make a full-time living from divining; for the typical diviner, witching is an avocation—a use of his gift to help a neighbor in need. True, he may charge for his services, but it is likely to be a token fee, typically about $25.

To explain exactly how and why the rod moves in the diviner's hands would involve a complicated discussion of physics and psychophysics and of the kind of rod used and the way it is gripped. Here we will confine our discussion to the standard, palms-up grip—by far the most common mode of witching.

If you grip the forked twig—palms upward, one fork in each hand, the forks pointing forward at an angle of 45 degrees, hands compressed toward each other—you can cause the rod to move by any of four very slight changes of grip.

First, because the rod is so taut, an imperceptible easing of your grip will cause the rod to rotate in your hands.

Second, a slight rotation of your wrists toward each other will cause the rod to dip; rotating them outward will cause the rod to move upward. Depending upon how much the rod is compressed by the initial grip, a very slight rotation of the wrists can impart a considerable "kick" to the rod.

The third and fourth ways to produce movement consist of pulling your hands slightly apart or pushing them slightly together. Either movement creates greater tension in the rod than in the force of the grip. By so upsetting the balance, the rod, acting like a coiled spring, may straighten out with such force that the bark literally comes off in your hands.

So far as we can tell, not one of the diviners with whom we are acquainted consciously makes the rod move. From his point of view, the rod moves of its own accord. Indeed, so convincing is his experience, the diviner will swear the rod was moved by some outside force, and may insist that he was actually trying to keep it from moving.

The seemingly automatic, self-propelled motion of the rod is one of the many mysteries surrounding the ritual. Is there something special about witching that makes it a better-than-chance method for finding water?

Evidence is questionable

As you might guess, the evidence is sparse, of varied quality and highly controversial. Most of it, especially that favorable to the case for divining, is drawn from anecdotes and case histories. Some, however, is derived from field tests which have been deliberately arranged to evaluate the diviners' claims.

The only evidence that can properly be called scientific has been obtained from a handful of laboratory and field experiments which did provide an objective base-line. An excellent example is an experiment performed in Maine under the

Experiments match divining abilities of "witches" against those of geologists and engineers.

auspices of the American Society for Psychical Research. It is especially relevant since it was conducted by persons who were sympathetic or at least open-minded about the possibility that the claims of the diviners might be valid.

Twenty-seven diviners (22 men, 4 women and 1 adolescent girl) were tested separately on a field chosen to be free of surface clues to water. Each used his own mode of witching to select the "best" spot for drilling a well, and was asked to estimate the depth at which water would be found, as well as the amount. Each was subjected to a second test, this time blindfolded to eliminate any visual clues.

As a control, the experimenters systematically selected 16 sites which covered the area in a representative manner. A geologist and an engineer were asked to estimate the depth and amount of water to be found at each of these sites. After the diviners had picked the "best" locations, test wells were sunk at each, and at the 16 assessed by the experts, and the depth and amount of water were measured. The experts did a good job of estimating the depth at the 16 specific points, but did poorly at estimating the amount. The diviners, on the other hand, failed completely to estimate either the depth or the amount of water at the locations they had selected.

The experimenters reported that "Not one of our diviners could for a moment be mistaken for an 'expert' . . . we saw nothing to challenge the prevailing view that we are dealing with unconscious muscular activity, or what Frederic Myers called 'motor automatism.' "

There is no need to cite the results of other investigations; indeed, we know of no acceptable laboratory experiment that supports the claims of believers. Both believers and skeptics agree that the most favorable evidence for diviners' claims is to be found in anecdotes and retrospective accounts, and that as we move closer and closer to the controlled experiment and the laboratory, there is less and less evidence that diviners possess any power to detect water.

But this is as far as the agreement goes. The skeptic, of course, interprets this as evidence against the validity of witching; it cannot be justified on the basis of scientific standards. The believer, on the other hand, attributes the failure to the inadequacies of the scientific approach. He claims that the witch produces "when it counts"—in his home environment, unhampered by the artificialities of scientific control and unhindered by skepticism.

These counterarguments are a "rationale for belief" that tends to avoid the problem of scientific confirmation. The following are repre-

sentative of the arguments we encountered.

The "test of time" argument. Solco Tromp, who attempted to justify water witching in terms of physical theory, wrote: "Nonetheless, undeterred by public ridicule, persistent generations of dowsers have upheld their belief for at least 7,000 years, almost as long as civilization itself has existed. This should suggest even to the most critical scientist that there may be some possibility of truth in the stories of diviners." Even if we overlook the fact that Tromp has added 6,500 years to the known history of divining, longevity seems to be a poor substitute for scientific confirmation. This argument would call upon us to acknowledge the validity of such ancient practices as astrology, palmistry and other forms of divination which still survive.

"Core of truth"

The "core of truth" argument. Almost as frequently offered, and usually coupled with the first, is the proposition that even if individual cases for witching cannot be scientifically confirmed, taken together they must contain "a core of truth." This recalls an old Chinese saying, "If a thousand people say a foolish thing, it is still a foolish thing."

The "testimonial" argument. When we refuse to accept the first two arguments, the defense can be relied upon to offer the testimonials of famous men. However, for every prestigious figure who has endorsed it, there are a sizeable number of equally prestigious persons who have denounced witching.

The "It would be a good thing for mankind" argument. "O.K.! So maybe the evidence at the moment is not scientific, but by opposing water witching you may be impeding the development of something that might help mankind" is a typical introduction to this argument.

In reply the scientist can only reiterate that he does not decide truth and falsity on the basis of desirability. Almost every major scientific boner—and there have been many—can be traced to a zealous desire to see the world as we think it should be rather than as it actually is.

The "artificiality of the scientific conditions" argument. Many of the arguments amount to a plea for special dispensation from the requirement that judgment be based on ordinary scientific standards. One version asserts that the diviner cannot perform well under scientific scrutiny because the controlled laboratory-like conditions are artificial. Another version argues that the witching "powers" are so sensitive and delicate that they are adversely affected by the skeptical atmosphere characteristic of experimental inquiry. One claimed that "It is often the subconscious wish of many research workers to obtain a negative result." But the essence of scientific inquiry is doubt and questioning. The scientist cannot give his seal of approval to a phenomenon that is said to exist only when

Water witching rod says "Dig here," while the geologist will only say "There's a possibility."

and if he is not looking!

When we conclude that water witching is a form of magic, we are tempted to conclude, also, that its use is a form of irrational behavior. This temptation should be resisted, for ritualistic and magical behavior is not necessarily irrational. Indeed, it can be argued that under some circumstances the resort to the diviner can be defended as a rational choice among available alternatives.

When the farmer needs to find water as quickly as possible, he is likely to look for the most immediately accessible solution to his problem, even if it is of questionable validity, rather than search for a more valid solution that involves long delay and great effort.

Moreover, the valid, rational solutions offered by science—in the person of the geologist—are vague and nonspecific as compared with the clarity and authority emanating from the diviner. The geologist can only supply generalized information about the possibility of striking water; he qualifies his judgment; he cannot guarantee success; and he leaves to the farmer the task of pinpointing the actual spot at which to drill. But the rod's message is decisive and unambiguous. It says, "Dig here." And the diviner goes about his task with the certitude of blind faith.

It must be kept in mind, as well, that witching is most prevalent in areas where water is most difficult to find, where expert advice is unavailable, or where, because of unusual geological factors, the advice is inadequate. The farmer turns to the diviner because whether or not witching is invalid, the witch's judgment cannot be worse than his own. It is, under the circumstances, as rational a decision as any, for he has nothing to lose.

For safety's sake

Rarely, if ever, is the choice between witching *or* science. Often the choice must be made between witching or no help at all. Most frequently, though, the choice is to use the best expert advice *plus* witching. Like magical ritual in primitive societies, witching is practiced mainly in circumstances where current scientific and rational procedures are of no avail.

From the point of view of the individual who has to make a choice, there can be no rational rule for selecting among alternatives if there is no empirically or scientifically valid information upon which to base a decision. Magic is not always a substitute for or an alternative to science; as Malinowski said, it may be "the outgrowth of a clear recognition that science has its limits and that a human mind and human skill are at times impotent."

Our moving continents

by Bruce H. Frisch

If Columbus set out to discover America today, he would have to sail about 15 yards farther than he did in 1492. But if he had started his voyage earlier than he did, say 150 million years ago, Columbus could have gone from Spain to Newfoundland in hip boots.

Both are explained by the widening of the Atlantic Ocean between Europe and America. The two continents are riding conveyor belts going in opposite directions. Although no one has yet succeeded in stretching a tape measure from shore to shore and watching the separation increase, a flood of recent discoveries about our planet has convinced many scientists that all the continents are drifting across the face of the globe.

Hoping to confirm the theory further, scientists aboard the U. S. Coast and Geodetic Survey ship, *Oceanographer,* probed the coast of Australia last August. The evidence they gathered may show that Cape Naturaliste, at the southwest tip of Australia, was once joined to Antarctica.

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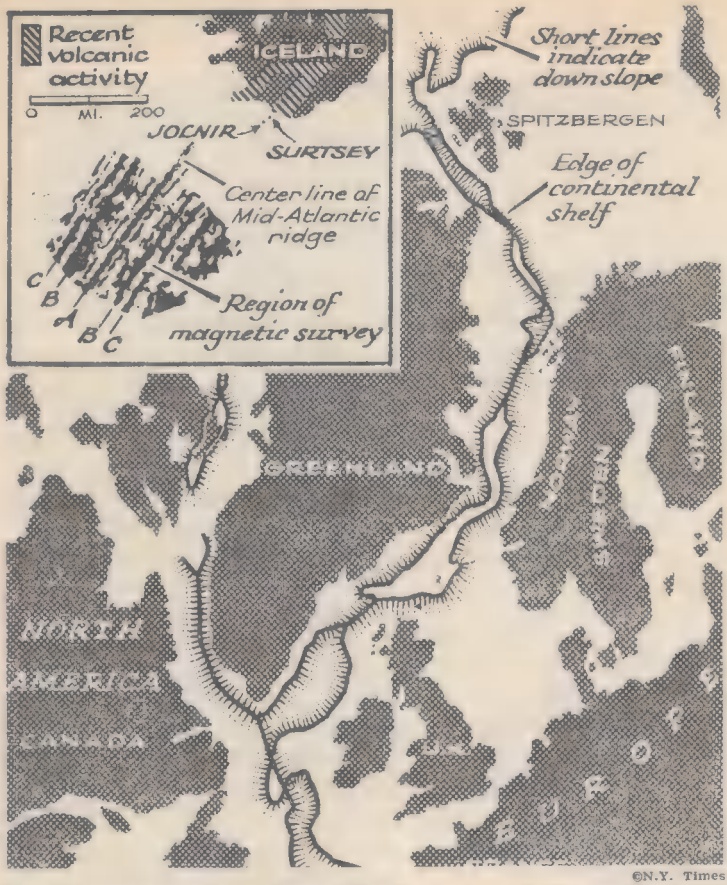
Icelandic and foreign scientists crowd the deck of their vessel for a view of the distant smoking volcanic vent and the two-year-old Surtsey, one of the new islands thought to manifest forces that have slowly pushed Europe and America apart.

The swing to the theory has been so fast in the last five years that the National Science Foundation will put up $5.4 million for a make-it-or-break-it test next year. The nation's four largest oceanographic institutes will cooperate in boring 70 holes up to 2,000 feet into ocean sediments and underlying crust. The question is, will the ocean history revealed jibe with that predicted by continental drift?

As pictured at present, all land mass was once packed into one or two supercontinents. During the age of reptiles, the supercontinents were broken apart, and pieces were carried as far as 4,350 miles to their present positions.

The neat way the pieces of this puzzle fit together started speculation centuries ago. It led German meteorologist Alfred Wegener to gather other evidence into the first comprehensive theory of continental drift in 1912. A modern assembly of some of the parts has been made by instructing a computer to calculate mathematically and draw "best fit" of the land around the North Atlantic at the edges of the continental shelf.

It wasn't enough that the continents match at their edges, Wegener reasoned. Imagine if he had cut the outlines of the continents from a newspaper page. When put together again, the print would line up across the cuts. He found his



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Large computer-drawn map shows how continents may have been joined 100 to 200 million years ago, before continental drift began to shift the land. Inset shows areas of recent volcanic activity in Iceland and magnetic field around mid-Atlantic ridge, and two new islands nearby, Jolnir and Surtsey.

"lines of type" in mountain chains. Across the South Atlantic, for instance, the Sierras of Buenos Aires matched the Cape Mountains of South Africa in age, structure, kind of rock and direction of trend. The same was true of the Canadian Appalachians in Nova Scotia and Newfoundland and the Caledonian System of Scotland and Norway. Yet there are no correlations between mountains formed after the age of chalk-forming sea animals.

A new match was recently added to the many others by scientists from M.I.T., Cambridge University and the University of Sao Paulo, Brazil. Starting at Accra, Ghana, on the underside of the bulge of West Africa, a line run-

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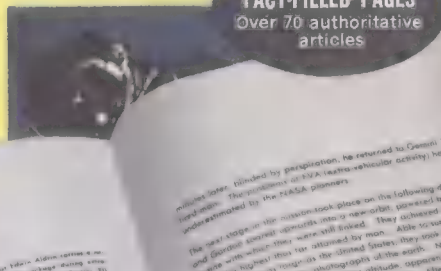

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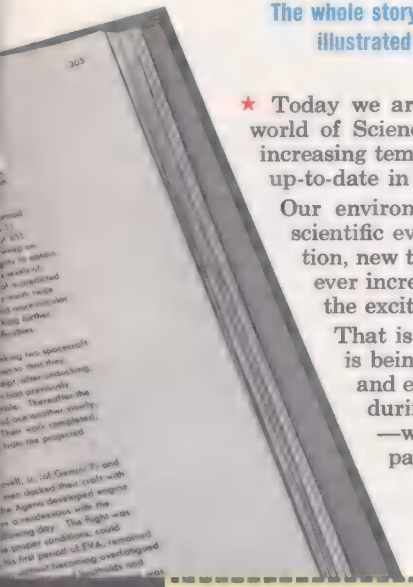

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ning northeast separates two-billion-year-old rock on the north side from half-billion-year-old rock to the south. The group marked the line on the computer-drawn map of abutting continents and continued it across Brazil. Sure enough, old rock was above the line, and younger rock was below; and they were of the same ages as those in Africa.

Another kind of line marks the northern edge of a glaciation that happened 300 million years ago. It runs through southeast South America, across Africa to the equator, over India about 2,000 miles north of the equator and chops off the southern third or so of Australia. There isn't enough water in the world to cover all this area with an ice sheet, a Scottish geophysicist has figured out. Yet when Wegener packed all these places together at the south pole, they made a neat, compact area, easily covered with an ice cap and with all the northern glacial boundaries end to end.

At the same time this ice cap covered India, coral reefs flourished in Spitsbergen, an island now at the edge of the Arctic ice pack. Later, Antarctica was covered with forests that were turned into seams of coal sighted by explorers in the early 1900s.

Attempts were made to explain these paradoxical climates by moving the geographical poles around, but Wegener did it with fewer contradictions by grouping his wandering continents near the south pole, then dispersing them northward. In North America, the Canadian paleobotanist, N. W. Radforth of McMaster University, points out that plants evolved complex leaves which could rapidly gather energy and turn it into plant matter, seeds which could preserve the species over a winter, and the ability to die above the ground in the fall while the roots remained alive underground and grew new stalks again with the advent of proper weather conditions. All fit in with movement from south to north.

Even garden snails were rung in by Wegener to support his case. One kind lives in western Europe and eastern North America and nowhere else. Just as suggestive was the lemur, a fox-like monkey which seems to have leaped the Indian Ocean from India and Ceylon to Madagascar. To explain such facts, paleontologists, who study animal fossils, had been imagining continent-size land bridges which conveniently disappeared below the waves at the appropriate times. Even Wegener's explanation was more believable than that.

But when skeptics wanted to know what force was strong enough to shove around whole continents, Wegener's ingenuity failed. All the forces he or his supporters could offer were too weak or unsubstantiated. The basic problem for both sides was a lack of knowledge about the earth. They chewed over the few facts available through the '20s, but during the '30s and '40s, the argument died, and the theory faded from memory.

Things popped after WW II.

Paleomagnetists learned how to examine the magnetic field the earth had millions of years ago, and discovered that a man living long enough could have stood on some of the continents and watched his compass needle make several complete spins. They had previously made a few excursions into the earth's magnetic history by studying lavas which become magnetized in the direction of the earth's magnetic field as they cool. But lava flows to the surface fitfully and only in certain places. Sedimentary rock is forming in many places all the time. Unhappily, while the magnetization of lava is strong, that of sedimentary rocks is one hundred times weaker.

Rocks tell story

In the early '50s, the geophysicist P. M. S. Blackett completed years of work on the ultrasensitive instrument needed. He had made it to prove a theory of his correct. Instead, his marvelous creation proved him wrong. But he and his colleagues at London University went on to score a triumph with the device by measuring the magnetization of red English sandstones.

According to these rocks, compasses in England 200 million years ago pointed 30 degrees farther west and dipped 35 degrees less. At the equator, a compass needle has no dip; it is horizontal. Over the north pole it points straight down. The group concluded that England must have since rotated 30 degrees clockwise and drifted 35 degrees of latitude, or 2,420 miles north. This thunderclap fell on deaf ears. It was a triumph only in retrospect.

Undismayed, the men from London University journeyed to India and shortly showed it may have drifted 4,350 miles northward to its present position.

No, a group from England's Newcastle University countered, the magnetic poles had wandered, and the continents had stood still. Their north pole set out 600 million years ago from Baja California, sailed off to the South Pacific, veered northward over the top of Japan, passed through Siberia and finally headed across the Arctic Ocean to its modern location west of Greenland.

Proceeding to new work, the Newcastle paleomagnetists came to the United States and measured Texas shales, Arizona sandstones and other rocks. When they were finished, they compared the trail of the wandering pole derived from American rocks with their original one for Europe. The two had the same shape, but did not fall on top of each other as they should have. Instead, they ran parallel, separated by 30 degrees of longitude, until they began converging around the age of reptiles, 45 million years ago. Their own data had tripped them up. They swiftly about-faced, explaining how Europe and North America must have been side by side until 45 million years ago when they started drifting apart by 30 degrees.

Discovery of mountain ridges down ocean centers supported theory behind continental drift.

Meanwhile, oceanographers had been pulling buckets full of surprises from beneath the waves. Our knowledge of the ocean bottom had been so sketchy that a 40,000-mile-long range of mountains up to 12,000 feet high had run undetected down the center of every ocean. Splitting the center of the ridge was a rift valley about nine miles wide and sometimes over a mile deep.

Discovery of the ridge put the finishing touches on a theory of the earth's formation that could supply the long-missing force behind continental drift.

In the beginning, according to this theory, swarms of stony meteorites drew together—literally fell together—into a cold globe. Gradually the trapped heat of radioactivity warmed the young earth. When heavy iron reached its melting point, it sank to the center. When light crustal rock passed its melting point, it rose to the surface. In between remained the heavier mantle rock. The only way heat can leave the earth is through the surface. It can't get there if it is generated deep within the earth because of the hundreds of miles of insulating rock overhead. The greater the depth, the more heat is bottled up, and the higher the temperature rises.

Like all materials, rock expands as it is heated. When expanded, it is less dense than the cooler rock above, so it begins to rise like a beach ball underwater in what is called a convection current. To see a convection current, watch oatmeal cooking or a thunderhead grow.

The number of currents in the mantle depends on the size of the core, according to a mathematical investigation by the Indian astrophysicist S. Chandrasekhar. At first, when the core was small, one current rose to the surface and spread radially across the face of the earth, losing heat as it went. At the opposite side of the earth from which it had risen, the now cooler and denser rock sank. All light crustal material was thus swept into a single giant continent where the current converged.

Later after the core had reached a certain larger size Chandrasekhar's calculations show, circulation in the thinner mantle broke up into three currents. These currents converged at two locations. As a result, the single giant continent was broken into pieces, then gathered into two heaps, the two continents from which Wegener started.

The unfolding of Wegener's tale of drift began with the changeover from three to four currents. The new pattern tore apart the two supercontinents and redistributed them to the new meeting places of downturning currents.

Several scientists immediately saw

that the ridge might be where the convection currents rose. Hot rising currents would account for the constant rumbling of earthquakes directly under the rift, and would also feed the volcanoes in Iceland, Surtsey Island, Tristan da Cunha and elsewhere that were located directly over the ridge. Temperature readings over the crest of the ridge showed that the heat flowing to the surface there was about eight times higher than on the continents. Heat flow through the ocean floor well away from the ridge was about the same as on the continents. This, too, seemed to confirm the theory. Two-thirds of the heat reaching the surface on the continents comes from the radioactivity in the crust. Since the crust is more than nine miles thick on the continents and just over three miles thick under the oceans, scientists expected heat flow under the oceans to be much less. It looked as if hot mantle currents were supplying the difference.

Conveyor belt underwater

The mountains of the ridge appeared to be material carried along by the current and piled up where the current diverged. Many oceanographers believe that the mountains are being constantly renewed from below as the material in them flows out across the ocean floor on either side, eventually descending into one of the five-mile-deep ocean trenches.

Thus there is a sort of conveyor belt running from the ridges to the trenches on which the continents are carried. When a continent reaches a trench, it can usually go no farther, and crumples its front end into mountains. Adding to the mountain heights is crustal material left behind by the belt as it starts its downward plunge. The Andes are an example. The Himalayas may have been thrown up by the collision of India with Asia. Our own western mountain belt may be unusually wide, suggests Princeton University geologist F. J. Vine, because North America has ridden right over the Pacific Ridge.

A proof of the conveyor belt is the oceanic islands, says J. Tuzo Wilson of the University of Toronto and author of one of the most modern versions of continental drift. Many of these islands began as volcanoes that thrust themselves above the waves over the mid-ocean ridge, just as Surtsey is doing today south of Iceland. The conveyor belt then carries them away. Islands near the ridge should be younger, and those far from the ridge, older. And this appears to be true. Tristan da Cunha and Ascension Island, almost on top of the ridge, are one million years old. Bermuda, about two-thirds of the way from the ridge to the Georgia coast, is 36 million years old.

After a volcanic island formed over the ridge has been carried away by the conveyor belt, a new one sometimes forms in its place. Several cycles like this stretch a string of islands, such as the Hawaiian group, across the ocean at

Dating volcanic rocks, geologists discovered magnetic reversals, adding up to moving continents.

right angles to the ridge. Where the process has been unfailing, the parting continents have left symmetrical trails leading all the way back to the ridge. Between South America and Africa, the Rio Grande and Walvis ridges, made up of a series of drowned volcanoes, meet at Tristan da Cunha on the Mid-Atlantic Ridge.

"The conveyor belt can also be thought of as a tape recorder," says Vine. The recorded message is the reversals in the earth's magnetic field. The same magnetized rocks that traced the paths of the wandering continents also showed that periodically the north and south magnetic poles switch positions. From 1961 to 1964, Allen Cox, Brent Dalrymple and Richard Doell of the U. S. Geological Survey, worked out the schedule of reversals over the last 3.5 million years. Using only young volcanic rocks, which can be dated precisely, they discovered nine turnabouts. The present direction has held for 700,000 years, but the field has been reversed just as much as it has been "normal." Cox and his associates estimate that a reversal takes 5,000 years, the wink of an eye on the geologic scale.

Vine saw a connection between these reversals and stripes of stronger and weaker magnetism which had been found to parallel the mid-ocean ridges. When the hot rock carried up to the ridge cools, he said, it must become magnetized in the direction of the earth's field at that time. A survey ship would then get a strong magnetic reading over rock magnetized in the same direction as today's field, and a weak reading over rock magnetized oppositely. By applying the dates of reversals calculated by Cox, Vine showed that the conveyor belt had indeed been moving and found out how fast. In the East Pacific, the speed is 1¾ inches per year; south of Iceland, about 0.4 inch per year; and in the South Atlantic, 0.6 inch per year. These figures back up the idea that the sides of the Atlantic are opening as if hinged at a point just north of Siberia.

Not all scientists, particularly some of the oceanographers at Lamont Geological Observatory who discovered the mid-ocean ridge, accept continental drift and the conveyor belt. Can we ever measure the speed of drift directly and settle any doubts once and for all? Yes, with the aid of satellites, says R. W. Tanner of the Dominion Observatory, Ottawa, but it will be decades before we can do it.

Many scientists do not need to wait; they are already sure. The question is no longer, "Have or have not the continents drifted?" says Blackett, but, "How much have they drifted and when?"

The psychology behind black power

"What do they want?" This has been the puzzled response of many when confronted with the cry "Black Power." Politicians, psychologists and sociologists have all speculated on the demands and needs that lie behind the Black Power philosophy. Because of the importance of understanding the underlying psychology of this new element in American life, we present excerpts—stressing the psychological points he made—from an interview with Dr. Nathan Wright Jr., one of the most articulate spokesmen for the Black Power cause and organizer of the Black Power conference held in Newark, N. J., the summer of 1967.—Ed.

Why black power?

Because it speaks to the two most pervasive problems in our society—identity and empowerment for fulfillment.

It is abundantly clear that black people have a negative sense of identity. The very term we use for black people in the census is "nonwhite." Our so-called riots are a form of self-destruction, a manifestation of self-hate.

And this whole problem of self-identity is a pervasive problem in American life. If you look at the people who fill our jails, our mental institutions, the people who go to our divorce courts, these are people

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This past summer, Newark, N.J., was the scene of a Black Power conference. Among those attending were the head of US, a West Coast group; national chairman of Student Nonviolating Coordinating Committee; a representative of the Southern Christian Leadership Conference. Dr. Nathan Wright Jr., standing in suit and glasses, was organizer.

who have problems of identity.

What we have to do is empower people—significantly black people—to realize whatever native potential they have so they can offer it and exercise it. To the black man this means social change, a massive urgent change.

The need now—to close the gap between where we are and America is as a whole—is for us to have a black purpose, to have black power. It is the most creative social concept in our present century. We will add to American society, not take from it.

Were you ever an integrationist?

Oh yes. This is one of the reasons why I can understand why people won't change. There appears to be a reasonableness about integration. But I've undergone the embarrassment as well as the pain of having to work out a new synthesis in my own mind.

There is no rising ethnic group in this nation that has ever asked for integration. They have asked for something that was integration plus—they have asked for desegregation, which means a clearing of the slate. And black people have asked for integration only when white people—people who represented power—took over the civil

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rights movement and foisted fictitious goals on the black community.

The whole business of asking for integration is an insult on its face. For one, it says that a black man has no worth except in the presence of white people. This is foolhardy. If no white man ever saw a black man, the white man wouldn't be diminished. And if no black man ever saw a white man in his life he wouldn't be diminished except in a cosmic sense, and neither you nor I know much about the cosmos.

Is there a difference between black and white men?

I think our historical and cultural experience has been different. These doctrinaire integrationists who try to say all people are alike are wrong. Yes, there is a common humanity, but we take to the common humanity our own unique experience, our unique integrity. Black people have not been facilitated in adding their unique insights and rich gifts to society.

Isn't the concept of black power unrealistic because there are many opinions as to what it ought to be?

No. We're not interested in consensus. Black people, when they come together, have decided to reject any white definition of what they are doing. Consensus means you gather right down the middle. But our purpose is to reach out in the widest possible embrace. We're interested in inclusiveness, in operational harmony.

What can the concept of black power do right now to avert further rioting?

It is only when people have a sense of power to control their own destiny that the conditions which lead to riots can be eliminated. My feeling is that the work of the Black Power Conference is going to be too slow to prevent any rioting this year or next year or the year after that.

The only thing that I feel could be done would be the precipitous facilitation of black power by people in our middle and upper classes of the white community. But these people do not have the predisposition to do it. In fact they would much rather get ready to mediate riots than they would to alter power relationships which would prevent riots.

We recognize that the problem of segregation in America is not an individual problem; it is corporate discrimination by white society as a whole; it is a cultural value system that all of us are inextricably a part of. Black people must address it in a corporate way. The root of our problem in the United States is not the prejudices of the white community against the black community; it is the faulty power dynamics exercised by black people.

Black people have skewed power relations today. The immediate cause of our so-called riots is white oppression. The basic cause is pathology in the experience of black people. And to prevent mounting unrest, black power is the thing that

is needed. The only way it can be facilitated is by the help of those who are least inclined to facilitate the empowerment of anyone—the white middle class.

How do you propose to "incline" them?

I address myself to this problem nearly every hour of the day because I feel the only alternative is disaster. One of the things I try to do is to give people a lively sense of the threat that is there so that they will be awakened out of their lethargy. I feel a lively sense of reality is our best hope. White America is in for a tremendously rude awakening, and I would like the awakening to be far more sober, reflective and helpful than riots.

How will black power be applied?

On those discrete points where all of us see a need, our immediate corporate resources are zeroed in on that need. And we don't need any relationship beyond where we see specific needs for specific times and specific circumstances. What we do is to form a framework that will bring our resources to discrete concerns.

And a discrete concern would be—?

Maybe in politics, maybe in economics, maybe in terms of bringing pressure to bear on specific circumstances. Our plan now is to develop the mechanism that allows this to be done. We do know, pragmatically, that such action does work.

Earlier you mentioned "desegregation" as a "clearing of the slate." Would you elaborate specifically on that?

Take the area of education. Black children do not need the presence of white children to learn.

When educators make surveys that black children learn better in the presence of white children, they are really talking about power, not the presence of white children. In other words they happen to be with children who have a sense of power, who have a sense of who and what they are and where they are going.

If black children had identity—a sense of control over their own destiny—you wouldn't negate them in a kind of self-defeating way by busing white children to be near them or to bus them to be near white children.

Now we have no black principal here in the Newark school system. What we are going to have to do—to allow a black teacher to move into the principal rank—is desegregate the school promotion lists by working with the school administrators to make them aware of this new kind of dynamics, to get them to operate on the principles of equity and restitution—which means make up for the past. This is not integration, but authentic desegregation, a new social understanding which our social scientists have not been predisposed to help develop.

Insomniac's nightmare—sleep

Insomnia plagues everyone at some time, and the more scientists study the enigma, the more they realize it means many different things to people—and few suffer as much as they think.

by Edwin Diamond

EVERYONE has, at one time or another, had trouble getting a good night's sleep; but one man's rest may be another's insomnia. Individual personality and physiological differences clearly influence the matter: some people appear to be more rested after six hours of sleep than others after eight or more. Moreover, even within the same individual, sleep reactions vary greatly: a full eight hours may find him completely refreshed one morning, utterly exhausted the next.

One of the few constants upon which sleep scientists can depend is the fact that insomniacs, though they do not imagine their suffering, tend to be inept judges of the amount of sleep that they are (or are not) getting. Recently Dr. Ar-

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thur Shapiro, an internist at the State University of New York's Downstate Medical Center in Brooklyn, and one of the principal sleep investigators in the United States, asked some of his allegedly sleepless patients to keep pads by their bedsides and to jot down the times of their awakenings through the night. Most of the pads were empty the next morning. Shapiro was not surprised; his previous studies had indicated that patients often believe that they are awake and worrying when they are actually in a light sleep or dreaming. He had also found that a series of mini-awakenings sometimes blends in the patient's mind into the impression of a long and sleepless night.

Of course, the difficulties of measuring insomnia provide small comfort for the legions of insomniacs, and the fact is that there is usually no simple cure for their ailment. They should find cheer, however, in a series of recent experiments and studies that have taken some of the mystery and subjectivity out of sleep disturbances.

Good night's sleep?

Just how much sleep should we get? One fact has become quite clear: the accepted standard for a good night's sleep—eight consecutive hours—is a social convention rather than a physiological requirement.

Years ago researchers discovered that the old physiological rhythm of childhood, the intermittent rest-activity cycle, persists into adult life. They detected this rhythm in the wavelike ups and downs of adult body temperature, which echo the infant's periods of wakefulness and sleep. The variations from the normal temperature of 98.6 degrees Fahrenheit are slight, on the order of a degree or so, but body temperature curves and performance curves fit hand and glove. Peak efficiency is achieved when the body temperature is also peaking, during the period of wakefulness.

Sleepers conform

Investigators concluded that the majority of sleepers, the conformists perhaps, have managed to adjust their up-and-down inheritance from childhood to meet society's requirements; their temperature peaks and troughs are in phase with the normal rhythm of society. They wake up spontaneously in the morning, bright-eyed, eager and apparently well-rested. Their brains warm up fast, their body temperatures crest early in the day; as a result, they can do their best work before noon, and they go to bed early. At the other extreme are those who have failed to fit their physiological rest-activity cycle to society's time pattern. They rise reluctantly—sour, slit-eyed and full of complaints about being tired. They warm up grudgingly to the day's activities, belatedly reach their temperature high and their alertness peak in the late afternoon or early evening. At 11 p.m. they are still keyed up and may have to turn on

the Late Show before they can simmer down and get to sleep.

Society has been slow to apply this understanding of alertness patterns to an efficient ordering of the day's activity and the night's rest. Business and industry generally make no adjustment in the 9-to-5 work pattern.

Psychological factors

But body temperature alone cannot account for all the observed patterns of sleep disturbance that populate the night. Psychiatrists assume, though they have never proved, that individual temperament shapes the quality and duration of sleep. They know that sleeplessness is often a precursor and accompaniment of mental illness. Physiologists assume, though they have never proved, that physical factors besides temperature influence sleep. Yet only within the last year has anyone taken the time to determine in a systematic way the physical and psychological attributes of good and bad sleepers. This groundbreaking investigation, conducted by a young psychologist named Lawrence J. Monroe, was described recently in *The Journal of Abnormal Psychology*.

Monroe began his study as a graduate student working in the University of Chicago sleep laboratories. He advertised for volunteers in the Chicago newspapers and eventually recruited 32 men between the ages of 20 and 42. He sought, in his own words, "mild insomniacs"—those who may take an hour to fall asleep and get in about five or six hours of sleep a night. Sixteen of these self-described mild insomniacs were matched as closely as possible by age, education and occupation with 16 others who claimed they were "good sleepers" —they usually fell asleep in 10 to 15 minutes and seldom awakened at night.

Monroe studied each sleeper for three nights. He found that those who said they were insomniacs were so indeed—though they claimed it had taken them, on the average, almost an hour to fall asleep on the three nights, whereas the actual time was more like 15 minutes. The poor sleepers awakened almost twice as often during the night as the good sleepers and shifted about on their beds much more frequently. Of the seven hours' maximum sleep time available under the experimental conditions, the good sleepers averaged 6 hours and 30 minutes of sleep, the insomniacs 5 hours and 45 minutes.

Some "won't let go"

The physical reactions of the two types of sleepers were quite distinct. The poor sleeper, Monroe found, stays closer to the wakeful state, as if he doesn't want to let go.

Monroe also found that the poor sleepers differed from their more fortunate fellows in two significant ways—the amount of their dream time and the depth of their sleep.

The average person spends

Studies show psychological split between good and poor sleepers and division of time spent in sleep phases.

about 20 percent of his slumber in dreams. In Monroe's experiment, the 16 good sleepers spent an average of 24 percent of their sleep in Stage I dream time; the figure for the insomniacs was 16.9 percent. And the difference was made even more striking by the fact that those insomniacs who had once had some form of psychiatric therapy actually garnered almost as much dream time (23 percent) as the good sleepers; the insomniacs who had never had any counseling had as little as 13 percent dream time.

Stages of sleep

A similar division between good and poor sleepers showed up in Monroe's analysis of their deep Stage IV sleep, presumably the most refreshing stage. The insomniacs "consumed" this part of their sleeping hours in the first half of the night and spent the second half tracing irregular sleep cycles. The good sleepers used up to 72 percent of Stage IV in the first half of the night and distributed the rest over the second half, preserving the smooth crest-and-trough, roller-coaster pattern. Once again, the insomniacs appeared unable to realize the most out of their sleep.

These indications of a psychological split between the two groups of volunteers were supported by the results of the two personality tests Monroe gave them.

A portrait of the poor sleeper emerges quite clearly from Monroe's study. His insomnia is real, not imaginary. Plainly, something is on his mind; he is psychologically anxious. He goes to bed in a state of heightened physiological activity, falls asleep with difficulty, gets an inadequate amount of dream time and distributes his deep sleep time in an erratic fashion. Small wonder that, when he awakens, he doesn't feel rested; small wonder that five of the 16 men in Monroe's poor-sleeper group said they derived little or no enjoyment from sleeping.

The recent discoveries of sleep scientists such as Monroe raise some intriguing questions about the future of sleep. If Stage IV deep sleep and Stage I dream sleep are somehow most important for physical and mental health, might it not be possible to achieve a supersleep limited to these stages? "We have courses that teach people to read faster," muses Brooklyn's Dr. Arthur Shapiro. "Perhaps we can also teach people how to sleep faster."

There are possibilities short of relearning how to sleep. Some investigators have speculated that the sleeper might be given some kind of drug regimen or electric current to bring about the right pattern of rest, but neither technique has thus far proved itself.

The Soviet Union boasts an electric machine that reputedly cures everything from insomnia and alcoholism to high blood pressure, skin disease and stuttering. The Soviet machine is commercially marketed in Russia and Europe under the name Electrosohn (Russian for "electric sleep"). The National Patent Development Corporation of New York, which holds the U.S. rights to Electrosohn, also has the patent for a smaller transistorized sleep inducer developed by Professor Omar Wing of Columbia University.

Soviet's electric sleep

Jack Snyder, a biomedical engineer with the Hoffmann-La Roche drug company, recently visited the Soviet Union in order to learn more about electric sleep therapy and to check out the extravagant claims made for it. He was told that there are more than 300 "sleep stations" in the Soviet Union, that some 500,000 patients have already been treated and that the technique is growing in popularity among some of the U.S.S.R.'s most reputable physicians. Snyder discovered, however, that the same percentage of subjects slept whether or not the current was on—a demonstration of the well-known placebo effect in which the mere presence of a white-coated figure busying himself about the patient often accomplishes recovery. Snyder does feel, though, that electric current applied to the central nervous system may have value other than as a sleep inducer, and he would like to see serious U.S. investigation of the technique.

Pending the millennial night of supersleep, what can be done to ease the lot of the poor sleeper? The first bit of advice might be: don't worry if you lose sleep occasionally. It is established that when healthy people stay awake through a single night—for work or for kicks—and enter the new day straight from the old, there are hardly any measurable physical effects.

A second admonition to insomniacs might be: see a doctor if sleep problems persist. A young suburban matron recently complained to her family doctor that she hadn't slept more than four hours a night for the previous three months. She was referred to a psychiatrist who diagnosed her problem as a classic case of an anxiety neurosis. What she feared at bedtime were her night thoughts and the encounter with her inmost emotions. "Sleep," the psychiatrist explained to her, "is a free-floating condition in which the sleeper has lost strict control over his thoughts. In severe anxiety, the sleeper cannot surrender to sleep for fear of what nightmare feelings he might encounter." Two months of psychotherapy helped her to sort out the tangle of her emotions; gradually she was able once more to discharge the pentup pressures of her psyche in dreaming sleep.

Of the sleep aids, barbiturates are the strongest and fastest-acting; they are intended to be sold only on prescription and taken under a doc-

Most sleep aids have little effect on the real insomniac, who should deal with doctor for help.

tor's care. But because of short-sighted M.D.s and pharmacists who look the other way, large quantities of these barbiturates fall into the hands of those who may not appreciate the fact that they are addicting or whose judgment has already been dimmed by emotional distress. The adult who begins to take pills in order to sleep soon develops a chemical tolerance for them. More and more pills must be swallowed each night to give the desired knock-out effects. Soon the typical victim may be taking 30 or 40 pills a night; 10 such pills would be enough to kill a non-addicted adult.

Addicting tranquilizers

Few laymen realize that many of the prescription tranquilizers (the second category of frequently prescribed sleep inducers) are also addicting. Often sedative-seekers take tranquilizers in tandem with barbiturates; the results can be synergistic—each drug increases the other's potency. In effect, Dr. John D. Griffith of the Vanderbilt University School of Medicine notes, "one plus one equals four." Alcoholic drinks are another synergizer.

The third class of sleep aids are the over-the-counter pills, available without prescription. More than 100 of these pills vie for public patronage, mainly through television ads. The over-the-counter pills, a medical spokesman for the leading brand explains, "are aimed at the ordinary, garden-variety type of sleeplessness—for the sleep problem that isn't serious but can be bothersome and chronic. They are not knockout pills for the serious insomniac, who should deal with a doctor."

It is certainly true that the sleep aids are mild. The big three in the field contain salicylamide, a key ingredient in aspirin, because, as one researcher explained, "We think a significant amount of people don't fall asleep because they have minor aches and pains." But the over-the-counter sleep aids—much as barbiturates and alcohol and tranquilizers—also act as central nervous system depressants, slowing the brain centers that control such vital functions as respiration and blood circulation. And while all such depressants apparently do help the pill-taker to fall asleep, no one knows the full extent of their effects upon the body.

The final bit of advice for poor sleepers might be to resign themselves to a certain amount of sleeplessness, particularly that associated with modern life and living conditions. What might be called environmental insomnia will always be with us. The product of food, drink, beds, marital condition and a dozen other homey variables, it could be laughed off—if the victim weren't so tired and irritable.

Maturity vs immaturity—There are times when "independent" domination of environment isn't necessarily desirable (as in the situation depicted above.) "Lady Bird Johnson's key to being the successful wife of a dominant man," say authors, "is to conceal her own strong personality in the velvet of appropriate dependence."

To be or not to be mature

Maturity is one of those enigmatic words used to describe a person or the way he is not. Dependence or independence may be the key.

by Flora Rheta Schreiber and Melvin Herman

EVERYONE likes to consider himself a "mature" adult. Can such an elusive characteristic be nailed down and scaled out? The answer, it turns out, is that a tendency toward a "mature" or "immature" approach to life's problems can, indeed, be indicated by measuring someone's degree of "dependence" or "independence" in given situations.

Recently, Drs. Herbert W. Eber and Raymond B. Cattell, both directors of psychology at Hillside Hospital in Birmingham, Ala., collaborated on a unique *Sixteen Personality Factor Text,* which has been incorporated into a handbook.

The eight questions in the quiz below have been carefully selected by the doctors for *Science Digest,* as indicators of your personal characteristics. The touchstone for equating your answer with "maturity," Dr. Eber points out, is the way you tend to put your independent characteristics to work

for you in your own environment.

"The test," he makes clear, "is merely an illustration of a scale that differentiates between passive and subdued acceptance of environment, and an active, independent need to dominate environment. The items are designed for illustration and are not clinical.

"Remember," he says, "that neither passive nor independent characteristics are necessarily desirable or undesirable. Everything depends on the situation in which they are brought to bear. In some situations, it may be very smart—and therefore mature—to be passive."

1. Would you rather be
   (a) a great inventor working in your laboratory, or
   (b) a great executive managing a sales force?
2. Are most wrecks caused by
   (a) people ignoring traffic laws, or
   (b) laws which are so unrealistic that they need to be ignored?
3. Is it most important
   (a) that people like you, or
   (b) that they do what you know is best?
4. Do most people nowadays
   (a) take their responsibilities too seriously, or
   (b) not seriously enough?
5. Do you learn more
   (a) from class discussion, or
   (b) from reading books and articles?
6. Is it more important
   (a) to find new ways to do things, or
   (b) to pay attention to the wisdom of the ages?
7. If you were lost in a strange town, would you
   (a) rather ask somebody the way, or
   (b) use a map?
8. Are most things better decided
   (a) by a wise and strong leader, or
   (b) by majority vote of many people?

What your answers mean:

You're the independent type if you've selected five to eight of the answers below, which were designed to reveal your wish to be independent and to alter your environment. The answers indicating independent, environment-dominating responses are: 1a, 2b, 3b, 4a, 5b, 6a, 7b, 8a.

The point is that, in many situations, there is a high correlation between independence, as here defined, and maturity.

Don't worry, if by selecting the statements which are not listed above, you have marked yourself as a person of passive, environment-accepting tendency. Consolation hinges on the word *tendency,* for only tendency is being tested. In a forced choice test, such as this, there are only two possible answers. Your measure may well lie between these two extremes, which is, of course, normal.

Miss Schreiber is an award-winning writer on psychiatry; Herman, the Executive Secretary of the National Association of Private Psychiatric Hospitals.

Flexibility is the key to Maturity: The most important element of maturity, Dr. Eber makes clear, is the ability to react appropriately to changing situations. Neither "independent domination of the environment" nor "passivity" is desirable in itself. There are times when "independent" domination of the environment" is desirable; times when "passivity" and not domination is called for. Quite understandably there are certain situations in life in which passivity and dependency are the better part of valor. Women, for instance, generally do better in our society, as Dr. Eber reminds us, by being at least somewhat less independent than men. This is a culturally-induced condition. In a different culture it might be otherwise. To accentuate the positive, we can say that *successful* wives are natural experts at the selection of the appropriately chosen dependent-yet-strong behavior. Lady Bird Johnson's key to being the successful wife of a dominant man, for instance, is to conceal her own strong personality in the velvet of appropriate dependence and show her independence at the proper time.

Right job "mold"

Appropriate independent or dependent mold is essential to job selection. This appropriateness in choosing the right job applies equally to men and women. The rule is "know thyself." Employers, too, must know what they want. Does he want an employee who will do as he is told and, therefore, one who is at least passive enough to accept his given environment; or an employee who is aggressively independent and can, therefore, make an imaginative contribution to the operation? Pity the poor employer who is caught between these polarities.

Suit yourself

Choose situations that suit your personality. This is the key to maturity and the success that maturity engenders. Perhaps you will like to test yourself in this respect by listing the factors of which your life pattern is composed. (Do you delay taking action, or act readily? Do you hoard or throw away things that have served their purpose? Are you regularly late or on time? etc.) Then underline the choices you would select if you had only your own thinking to guide you. If the two lists tally, congratulate yourself!

Introverts and extroverts show their maturity by choosing the life style suited to their temperaments. The introvert who chooses to head an aggressive sales force is immature. So, too, is the extrovert who devotes his life to research in the intricacies of poetic imagery.

You, however, are neither all extrovert nor all introvert. Nobody is all of a piece. Professional football players, for instance, need a great deal of aggressiveness in the field. In private life, however, many of them actually have less aggres-

sive personalities than the men in the grandstand. The real issue is: how can they carry their on-field personalities home with them so as to lead successful lives? Once again, to underline our central point, the case of the football players shows the need for appropriate action.

The maturity dilemma: Our culture encourages dependency. Yet we are all too apt to say that too much dependency is a sign of neurosis. Take, for instance, the complicated dependency relationship between a young boy and his mother. The emotionally mature mother doesn't overdo tying her child to her in dependency. But what does she do when the child gives signs of needing more of her? Is she more mature if she denies the child or if she fulfills his need?

Can you trust the personality tests? Many such tests have been designed. Though commercially successful, many are theoretically unsatisfactory. Even though tests are becoming increasingly sophisticated, personality itself remains so stubbornly elusive that some authorities shy away from any form of personality testing. Other authorities, while conceding that a full understanding of any personality is probably impossible, favor personality testing at least to the extent that, once its limitation is recognized, it can serve as a time-saver. While we can't measure friendliness, which comes and goes and often masks itself as its opposite, we can pinpoint the presence or absence of friendliness at any one moment in the same way that we can measure a man's height.

Emotional maturity, for instance, has been tested by Dr. Leah Gold Fein, a New York psychologist, through three questions. The first question is "Who am I?" The second: "What do other people see me as?" and the third: "What would I like them to see me as?"

Questions give answers

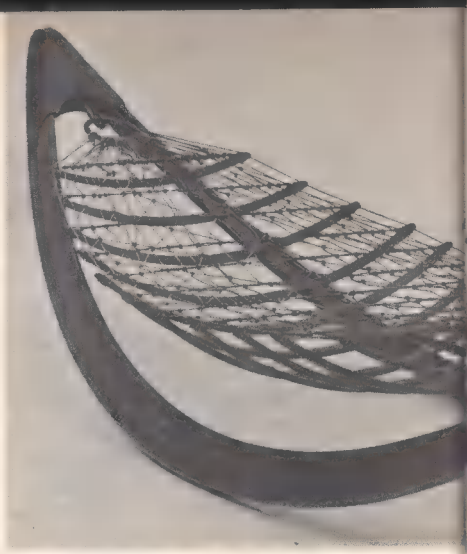
The psychiatrists and psychologists to whom we presented Dr. Fein's three questions agreed that this approach is sound and useful. Try it! It will give you a profile of yourself, for certainly you can't talk about who you are without showing how mature or immature you are. The differences between the way you'd like others to see you and the way they actually do, moreover, become a remarkable test of a mature attitude toward life.

"I'm not an adolescent anymore," the daughter of one of the writers said with a mixture of pride and wistfulness on her twentieth birthday. But adolescence does not end simply because we are in the world a certain number of years. The flip over to the side of maturity often demands ■ change in life style.

TECHNOLOGY

Sleep for swingers

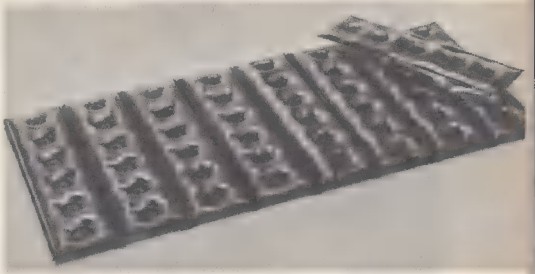
A comfortable reclining surface always has concerned man, resulting in sleeping accommodations of various shapes and embellishments. Pictured here are unique beds, cradles and rockers exhibited at a recent bed show at the Museum of Contemporary Crafts in New York City.



Rocking hammock is constructed of laminated teak, brass ends and nylon line. No antique, this rocker is for swinger set.

Wood bed with acrylic paint was designed by Thomas Simpson. Box near head of the bed is an old-fashioned music box.

Cherry wood and leather cradle is answer for mother seeking something unique in design.

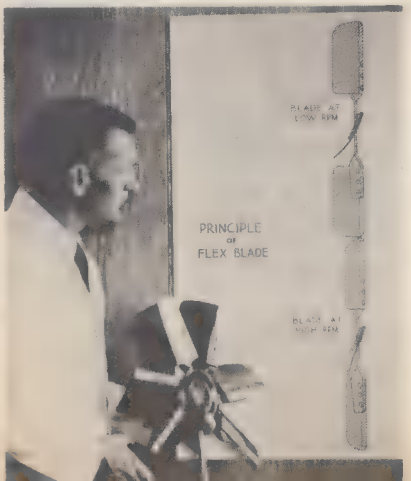


Individual snap-on vinyl and lucite inflatable panels permit bed to be made any size.

Oregon pine exterior cradle allows mother to pad interior with any material she desires.

Pine-painted bunk with ladder and slide makes bed-going or getting up fun routine for climb-up, slide-down young set. Routine could become problem to youngster who might prefer climbing and sliding to sleeping. Note storage space under bunk.

NEW FOR INDUSTRY



Television and laser technology united for first time in transmission and recording images of photographic quality. Designed for use in an earth resources observation satellite, the RCA system uses new TV camera tube that sends pictures to gas laser whose beam then traces them on photographic film at very high speeds.

Flexible cooler solves modern internal combustion engine air-cooling problems. Fan blades of 301 stainless steel type of Allegheny Ludlum Steel Corp. pulls more air through radiator of car at idling and low speeds. Blades "flatten out" as speeds increase, and the car's motion takes over most of the engine cooling assignment.

Sonar Air Dome is largest rubber product ever molded in one piece. Will help men on U.S. Navy desroyers improve their underwater hearing. The B. F. Goodrich product is 34 feet long, 11 feet wide and eight feet high, weighs more than eight tons when ready for attachment to a destroyer. Walls of the dome are reinforced with cables.

Landlocked ESSO Marine Training Center, Grenoble, France, enables veteran shipmasters to learn handling characteristics of huge supertankers through the use of models ranging in length from 20 to 42 feet. Largest replica is of 191,000 deadweight ton tankers. Models are in exact proportion to the vessels they represent.

Combination of urethane foam and precut 2-inch by 2-inch wood screeds cuts work time, costs of leveling floors in rehabilitating buildings. Rigid urethane foam is frothed underneath the leveled screeds with foaming equipment. System for use in old tenement buildings developed by Forest Products Marketing Laboratory. Renovation of 5-story building done in 48 hours.

STEM (Storable Tubular Extendible Member) masts and antennas originally used in spacecraft now are available in consumer markets in sizes 1⅜ inches in diameter, which hoists a 10-pound tip load, to 28 feet and 3⅛ inches in diameter, capable of lifting a 75-pound load to 50 feet in winds 50 mph. May be mounted on fixed sites or vehicles.

Lions that live in trees

THE king of the beasts is quite naturally lord of his own home, and while this is usually on sandy plains, there is one breed of royal cat that has taken to the trees. Lions in the Lake Manyara district of Tanganyka decided long ago, according to native legend, to move up in life. So they did, but only for the pleasurable aspects of life—sleeping and resting—not hunting, like their spotted relative, the leopard. And while climbing trees is common for most cats, as owners of the domestic variety know only too well, the lordly lion normally considers it undignified and too much trouble. So why lions in this one region of Africa have chosen to stray from the plains is a mystery, except to the lions.

Oh for the life of a king—especially this beastly royalty (above) who seems content in his awkward position. This sleeping cat is a rarity among lions because he lives in the African region where all lions live in trees instead of sandy plains. Below, a lionness peers down from her lofty abode while her mate sleeps quite comfortably.

Not every fish pond can make the claim that it houses ■ baby submarine as well as a school of golden carp. The submarine, **Asherah**, named for ■ Phoenician sea goddess, is shown arriving at the University Museum at University of Pennsylvania.

Submarine in a fish pond

VISITORS to University Museum at the *University of Pennsylvania* may be startled by the sight of a submarine cradled on the floor of the fish pond. It's a little sub—17 feet long, weighing 8,500 pounds—but it has a big story. Named for a Phoenician sea goddess, *Asherah* descended 300 feet below the surface of the Aegean Sea last summer.

Asherah made the descent off Bodrum, Turkey, to explore an ancient Roman shipwreck which had lain on the ocean floor for more than 2,000 years. Built for the University Museum in 1964 by the Electric Boat Division of General Dynamics, *Asherah* spent the summers of 1964 and 1967 exploring that shipwreck on the floor of the

Aegean. The sub is on temporary display at its proprietor's, in the company of golden carp.

It carries two passengers—an operator and observer—and can go down to a depth of 600 feet for work on the Continental Shelf. The *Asherah* is capable of remaining below surface with its crew of two for about four hours at a time.

Turning growth on, off

An irradiated, milky yellow extract from potatoes has been used at the *University of Michigan* to inhibit and stimulate mitosis, growth by cell division. There were no apparent ill effects on the treated cells. The extract, subjected to low radiation, significantly controlled the growth of plants, yeast and microscopic animals.

Lloyd E. Brownell, professor of chemical and nuclear engineering, foresees the possibility of using the extract for such diverse applications as increasing crop yields and arresting the growth of tumors.

It has been demonstrated that the potato extract causes peas to grow at four times their normal rate. Prof. Brownell irradiated and replanted a normal crop of mature russet potatoes shortly after harvesting them. The treatment resulted in a second crop before the first major winter freeze.

In an unrelated study, Dr. Albert Szent-Gyorgyi, Hungarian-born Nobel Prize winner, is studying two biochemicals of the human body. He has found these chemicals to influence mitosis of the body cells. Dr. Szent-Gyorgyi considers these mitotic agents to be part of a control mechanism common to various forms of life. He calls them "Retine" and "Promine".

Retine retards cell division, making it a mitotic inhibitor. Dr. Szent-Gyorgyi has isolated and purified Retine and demonstrated its use in stopping mitosis in microorganisms as well as in cancer cells grown in culture. He is presently working on a chemical synthesis of Retine.

Prof. Lloyd E. Brownell, left, and Dr. B. N. Kabadi, University of Michigan researchers, examine one of the potatoes from which a milky yellow biochemical has been extracted and used experimentally to both inhibit and stimulate the growth of plants, yeast and microscopic animals.

Is yours the special kind of mind that has to know...

. . . how nocturnal animals see, hunt and live in the dark—and how the "night" zoos fool them into thinking it's dark in broad daylight, so people can watch them?

. . . what happens to children who lose their hearing before they're five; how modern science is curing many, and teaching others to communicate as well as anyone?

. . . why the ancient men of Britain built mystic circles of monolithic stone all over England—some of them more curious than Stonehenge —and what recent discoveries have revealed about them?

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WSD911

MEDICINE

Night eaters—always on the prowl

By Arthur J. Snider

DURING the day they eat almost nothing. At dinnertime they pack away a hefty meal with seconds and thirds, but it isn't enough. The determined prowl for carbohydrates commences right after dinner and continues until bedtime. They hate themselves in the morning because their sincere intention of maintaining self-control has vanished. They are known as "tension night eaters," the most perplexing type of obese patient to treat, say two Chicago physicians.

Drs. Frank L. Bigsby and Cayetano Muniz differentiate the tension night eaters from other forms of unrestrained obese:

Obese compulsive eaters: They are constant snackers, seldom sitting down to a regular meal. Food is used to combat anxieties. They are completely disorganized.

"The housewife frequently refers to herself as the 'garbage pail for the children' and even seems proud of the fact that she eats on the run," the physicians explain.

The late-late night eaters: They do not snack between dinner and bedtime, but after being asleep for some time they will awaken, unable to sleep again until they raid the refrigerator.

"The explanation for this phenomenon is unclear," Dr. Bigsby states. "It is conceivable that the

physiological response to food corrects a mild hypogylcemia (low blood sugar)."

The mid-evening snackers: They eat at night as a matter of habit or conditioned reflex, and are relaxed rather than tense. Food provides a sense of security and well-being.

The hobby eaters: They reach for carbohydrates at any hour because of the pure joy of delicacies. Tension isn't the motivator; it's the love of food.

To learn how prevalent tension night eaters are, the doctors tabulated findings on 500 consecutive new obese patients. They found 302 had coffee and a roll or juice, and 146 had nothing or only coffee

for breakfast. At the noon meal, 327 ate a sandwich or beverage; 49, a salad or fruit; 68, no lunch at all. Only 28 of the 500 said they never snacked, and 427 started their snacks after 4 p.m.

As treatment, the physicians prescribe mild sedation to control tension; a balanced dinner, leaving one-fourth of each food portion; curtailing late afternoon and after-dinner snacks; 3 ounces of unsweetened orange juice with breakfast, two hours after breakfast and one hour before dinner; 6 ounces of skim or 2 percent milk three hours after lunch; no appetite-depressing amphetamines before 4 p.m.; curtailment of coffee, chocolate, colas or strong tea; a high protein, low carbohydrate breakfast and lunch.

"Instant" skin for burned

An "instant" artificial skin that can be worn for months or years, if necessary, has been developed at Tufts University School of Medicine. The synthetic material, which has the soft look and feel of velvet, was developed as a covering for denuded areas in the event of severe, life-threatening burns.

Like human skin, it is made of three layers—an outer, resilient layer of nylon velour to seal edges, a middle layer of silicone to prevent water loss and an inner layer of fine nylon velour loops to maintain adherence. It is not a biological dressing or a cosmetic coverage, says Dr. Donald P. Dressler. It is actually a prosthetic skin for skin's sake.

Eventually, it would be replaced by transplanted human skin, but this would come at a time physiologically right for the patient.

An advantage is function, says Dr. Dressler. Where normal skin would take several months to grow back, an instant prosthetic skin would permit early motion in the hands, for example.

Despite the medical gains over the last half century, the mortality rate in patients burned over 50 percent of their body remains unchanged. In Dr. Dressler's tests on rats burned over 20 percent of the body, the mortality rate was 61 percent when untreated and zero when given prosthetic skin. When the burn trauma was stepped up to 40 percent of the body, the mortality in untreated rats was 100 percent and in prosthetized rats, only 10 percent.

Computerized physicals

A computer about the size of a household refrigerator is handling the entire load of biochemical testing at Perth Amboy (N.J.) General Hospital. Dr. Hugo C. Pribor, director of laboratories, says up to 20 different tests can be run on a patient for no more than he now pays for two or three normally

prescribed physical examinations for employment, insurance, hospital or college admission.

In addition, the computer will offer diagnoses on such diseases as cirrhosis, nephrosis (kidney), multiple myeloma (bone marrow) and heart damage. Plans are being made to add Papanicolaou smear diagnosis of uterine cancer. Automated screening can eliminate certain negatives, the 90 percent or more patients with no cell abnormalities, thus enabling the doctor to concentrate his attention on the rest.

Automation of the laboratory can increase the ability to handle a mounting data load, said Dr. Pribor. The laboratory test load today averages 5 to 7 per patient nationally compared to 1 or 2 in 1954. At the same time, the technician shortage is about 30,000.

Drug hits heart menace

A surgeon has brought his own cholesterol blood level down to that of a newborn baby, using a drug he believes will have a profound impact on heart disease.

Three years ago, Dr. Robert Fuson's cholesterol level was 250 milligrams, which placed him in the risk bracket. Today it is below 75 milligrams, and often ranges in the 40 to 50 level.

Dr. Fuson, a surgeon at Duke University, takes the yellow powder, cholestyramine, dissolved in water, three times a day. It is also being tested on 65 patients, many of whom have advanced hardening of the arteries. Their average reduction is 60 percent.

The drug is now before the Food and Drug Administration for approval. It apparently works by combining with the bile acids in the intestines, causing them to be excreted rather than reabsorbed. This compels the body to make more bile acids. Since bile acids are normally from cholesterol, the blood cholesterol level is lowered.

Cholesterol has been implicated as a key ingredient in hardening of the arteries, a leading cause of heart attacks and strokes.

In addition to reducing cholesterol levels, the drug can reduce fat absorption, thus making it potentially useful as a weight-reducer, Dr. Fuson says. His own weight has dropped 50 pounds.

Cholestyramine is not a new drug. It was developed several years

ago to relieve itching associated with some liver diseases. But Dr. Fuson said it tasted so bad patients couldn't take it. Now the yellow powder is mixed with water and tastes like artificial orange juice.

Thin blood a blow to cancer

A "blood thinning" treatment used for heart patients is being tried experimentally to check the spread of cancer from its original site to other parts of the body. Animals with cancer have been fed anti-coagulants to reduce the blood's ability to clot.

The theory is that a thickening and solidifying of blood tends to cause free-floating cancer cells to adhere to the lining of the blood vessels. These cells then pass through the vessel wall, lodge in tissue far removed from the primary cancer site and begin dividing and multiplying to establish new cancer colonies in other parts of the body.

If an original cancer can be prevented from spreading (metastisizing), presumably the patient could be cured by surgery or radiation. It is when cancer cells have broken off from their primary site and traveled via the blood stream and lymph system to new points of deposition that surgery and radiation are handicapped.

Drs. S. Kirby Orme and Alfred S. Ketchum of the National Cancer Institute said the idea still must be demonstrated in man. However, there is an impression that fewer cancer deaths are seen in patients undergoing anti-coagulant therapy for coronary artery disease than in the general population, and the spread of cancer to distant sites in the body is rare. There is also some suggestive evidence that anti-coagulants may retard the local growth of the original cancer as well as blocking spreading.

Alcoholism—just a habit?

A physician suggests considering the "common sense notion" that excessive drinking is a habit, not a disease. If looked at in this light, something might be done about preventing or treating it, according to Dr. R. E. Reinert of Topeka, Kan. As a disease, alcoholism demands finding a cause, a search in which many experts have spent much time and energy futilely.

Dr. Reinert points out some people think alcoholism is too compelling to fit the notion of a habit, but he adds, "Never underestimate the strength of a habit." Alcoholism could be a "learned pattern" like any other well-ingrained habit that has become "crystallized, automatic and no longer subject to individual decision."

Chief of staff of the Topeka Veterans Administration Hospital, Dr. Reinert says a considerable amount of alcoholism starts as a "style of life" in which a group of individ-

uals enjoys drinking as a social activity. The only compulsion involved at that point comes from members who want to see that nobody misses a round. Eventually, the pleasurable practice becomes a habit, and ultimately, a trap into alcoholism.

A club for the long jawed

You can't belong to the "Long-jaw Club" in Chicago unless you've undergone prognathic mandible surgery. This operation corrects a condition in which the individual's lower jaw protrudes excessively, causing abnormal appearance, difficulty in chewing and impossibility of fitting dentures properly.

The club was organized by Miss Dixie Flynn, a dental assistant in Streamwood, Ill., who underwent surgery two years ago. Its purpose is to give advice to patients who are considering prognathic mandible surgery.

"I can provide the patients with the medical answers," says Dr. Nicholas C. Choukas of Franklin Boulevard Community Hospital, Chicago, "but I myself have never experienced the surgery as a patient, so I can't tell how it will feel or provide other information that only a patient could really know."

One of the ordeals of the operation is that the patient's jaws are wired shut for six to eight weeks. The diet is restricted to liquids. Miss Flynn's imagination came up with such tasties as melted peanut butter, melted puddings and a variety of liquid diet drinks.

Regrowing limbs foreseen

Human beings one day may be able to regrow damaged or amputated limbs, believes Dr. John R. Platt, a biophysicist at the University of Michigan.

With millions of people suffering cuts and disfigurement from accidents every year, and with their

medical costs running to billions of dollars, the payoff from such studies could be very high, he says.

"It might take a small task force of developmental biologists only a few years to come up with important advances along these lines, if the nation were willing to set such a group to work on these problems as it sets groups to work on military or space problems," he told a recent national conference.

Each month Dr. Isaac Asimov chooses one of the questions you send in to answer. He does not make the job easy on himself, for in past months he has written about such things as relativity, parity and the basic nature of light. Following Dr. Asimov's answer are the answers to some of your other questions written by regular members of the Science Digest staff.

Science fictionally speaking

In many science fiction stories I read about "force fields" and "hyperspace." What are these and do they really exist?

Every subatomic particle gives rise to one or more of four different kinds of influences. These are the gravitational, electromagnetic, weak nuclear and strong nuclear. Each influence spreads out from its source of origin as a "field" that, in theory, pervades the entire universe. Similar fields from large numbers of particles can add their separate influences and produce terrifically intense resultant fields. Thus, the gravitational field is by far the weakest of the four, but the gravitational field of the sun, a body made up of so vast a number of particles, is enormous.

Two particles within such a field may be made to move toward each other or away from each other, depending on the nature of the particles and of the field and with an acceleration depending on how far apart they are. Such accelerations are usually interpreted as caused by "forces," so we speak of "force fields." In this sense, they really exist.

The force fields we know, however, always have matter as their source and don't exist in the absence of matter. In science fiction stories, on the other hand, it is often useful to imagine the construction of strong force fields without matter. One can then have a section of vacuum which will serve as a barrier to particles and radiation just as though it were a solid piece of steel six feet thick. It would have all the interatomic forces but none of the atoms that give rise to those forces. Such "matter-free force fields" are a convenient science fictional device but, alas, have

no basis in the science we know today.

"Hyperspace" is another convenient science fictional device; one intended to get around the speed-of-light barrier.

To see how it works, think of a large, flat sheet of paper on which there are two dots six feet apart. Next, imagine an extremely slow snail that can only travel a foot an hour. Clearly, it will take him six hours to travel from one dot to another.

But suppose we bend the essentially two-dimensional sheet of paper through the third dimension, so as to bring the two dots close together. If they are now only a tenth of an inch apart and if the snail can somehow cross the air gap between the two ends of the piece of paper which have been curved toward each other in this fashion, he can go from one dot to the other in just half a minute.

Now for the analogy. If two stars are 50 light-years apart, then a spaceship going at maximum speed, that of light, will take 50 years to go from one to the other (relative to someone in either one of these star-systems.) This creates a great many complications and science fiction writers find they can simplify their plots if they pretend that the essentially three-dimensional structure of space can be folded through a fourth spatial dimension so that the stars are separated by only a small fourth-dimensional gap. The ship then crosses this gap and goes from one star to the other in a very short period of time.

It is customary for mathematicians to speak of objects with four dimensions by referring to analogous three-dimensional objects and adding the prefix "hyper," a Greek expression meaning "above," "over" or "beyond." An object whose surface is equally distant from the center in all four dimensions is a "hypersphere." Similarly, we can have a "hypertetrahedron," "hypercube" and a "hyperellipsoid." Using this convention, we can speak of the fourth-dimensional gap between the stars as "hyperspace."

But, alas, however convenient hyperspace may be to the science fiction writer, there is nothing in the science we know to show that it exists as anything but a mathematical abstraction. —*Isaac Asimov*

I have heard that in 1938 fishermen caught a 70 million-year-old fish off the coast of South Africa. What is the truth about this "living fossil?"

The fish is the famed coelacanth, *Latimeria chalumnae*. Of course, the individual fish caught in 1938 was not 70 million years old, but it was a representative of a class of fishes believed extinct for that long.

The coelacanths are large fishes, weighing up to 180 pounds. They are covered with heavy scales and are generally unattractive look-

ing. The most striking, and scientifically important feature of this fish are its lobed fins, believed to be forerunners to the development of the legs of higher animals. The skull, too, resembles that of the primitive amphibians, and this has led scientists to conclude that the coelacanths are members of the group from which all amphibians, and therefore all later land and air vertebrates sprang.

The first specimen caught in 1938 badly decomposed before it reached the hands of scientists. Since that time nearly a dozen other specimens have been caught, and a system of catching, preserving and transporting the fish by air has been established by the Madagascar Institute of Scientific Research.

In a recent book, "The-Ever-Changing Sea," by oceanographers David B. Ericson and Goesta Wollin, the authors state: "Oddly enough all coelacanths have been caught in fairly shallow water, that is, at depths between 180 and 1,200 feet. Probably they descend to greater depths; little fishes found in their stomachs belong to species that live at (much greater) depths, but even so they are not really deep-sea fishes. It seems strange that they had not been caught long before."

The oceans have not proved to be refuges for ancient types of animals as once believed, say oceanographers Ericson and Wollin. "We can be sure now that assemblages of archaic forms will not be found in them."

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Develop A Powerful Memory?

A noted publisher in Chicago reports there is a simple technique for acquiring a powerful memory which can pay you real dividends in both business and social advancement and works like magic to give you added poise, necessary self-confidence and greater popularity.

According to this publisher, many people do not realize how much they could influence others simply by remembering accurately everything they see, hear, or read. Whether in business, at social functions or even in casual conversations with new acquaintances there are ways in which you can dominate each situation by your ability to remember.

To acquaint the readers of this publication with the easy-to-follow rules for developing skill in remembering anything you choose to remember, the publishers have printed full details of their self-training method in a new booklet, "Adventures in Memory," which will be mailed free to anybody who requests it. No obligation. Send your name, address, and zip code to Memory Studies, 835 Diversey Parkway, Dept. 690-011, Chicago, Ill. 60614. A postcard will do.

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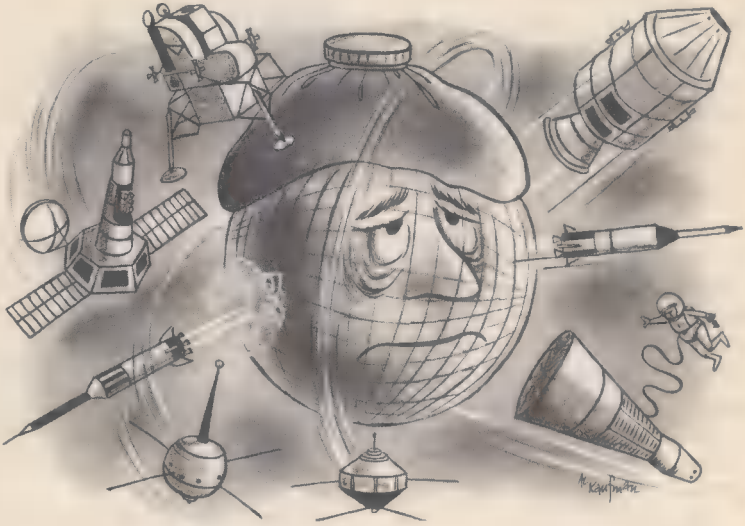

Space jargon

by John and Molly Daugherty

SPACECRAFT, rockets and probes are a few of the terms used in space work. Spacemen groaned when a public official proudly proclaimed "a rocket on its way to Mars" when, in reality, the rocket that launched the *probe* was buried under three miles of water in the South Atlantic. Objects launched into space are generally *satellites* or *probes*, the latter being those going beyond mere earth orbit into space.

What do you know about some of the widely used spacecraft jargon?

1. Timing, important in space work, is often measured to hundredths or thousandths of a second. "What time is it?" in space terminology is expressed by a
   a. Chronograph
   b. Time hack
   c. Timetable

2. Telemetry is a system for
   a. Receiving a signal or pulse to initiate a sequence of action
   b. Showing the position of the spacecraft's axes, usually in relation to the earth's surface
   c. Taking measurements within the craft or on the ground and transmitting them by radio

3. Rotation of a space vehicle on its lengthwise axis is called
   a. Roll
   b. Yaw
   c. Pitch

4. The present meaning of the word *glitch* in aerospace work is

a. Limited to voltage irregularities in electronics
b. A "foul-up" of inanimate things
c. Poor workmanship traceable to a particular person

5. A gimballed rocket motor is a device to
a. Inject the spacecraft into a precalculated orbit
b. Apply force to jettison an instrument package from the craft
c. Correct for movements of pitching and yawing

6. One problem of space vehicles under "weightless" conditions concerns the closed tanks containing fuel for engines. The fuel doesn't have a "volume" above the surface of the liquid fuel. Small rockets must be fired to get a "gravity" effect to move the fuel to the bottom to feed the engines. In space jargon this is known as
a. Ullage
b. Drogue
c. Jettison

7. Ablating material is
a. An oxidizer used in rocket propellant
b. A plastic-like substance to dissipate heat on reentry
c. A winglike element on a spacecraft to give greater stability in flight

8. Boilerplate is
a. A model of full size and weight but lacking most of the functional features
b. The hollow part of a metal connector to which a probe part fits
c. The metal tank for holding liquid fuels

9. Apogee is the
a. Point at which an artificial satellite in orbit is nearest the earth
b. Point at which an artificial satellite in orbit is farthest from the earth
c. Distance from the earth to the satellite when it is nearest the earth

10. Hypergolic refers to
a. A self-sustaining orbit with momentum equalizing the gravity force—a parking orbit
b. Methods of attaining extremely low temperatures
c. Combinations of bipropellants which ignite spontaneously when they make contact with each other

Answers:

1—b Time hack. For example, the time of splashdown at the end of a mission may be recorded as 7:42:13, meaning 7 hours, 42 minutes and 13 seconds. Timing of events after lift-off may be affected by slight changes in the force of gravity. These slight variations depend on the time of day when lift-off occurs.

2—c Taking measurements within the craft or on the ground and transmitting them by radio. Usually the measurements are transmitted to other tracking stations.

3—a Roll. The lengthwise axis is called the longitudinal axis or merely the X axis.

Pitch is rotation about a Y axis that is perpendicular to the X axis and horizontal with respect to the earth's surface.

Yaw is motion about a third axis (Z) which is perpendicular to the other two at their point of intersection.

4—b A "foul-up" of inanimate things. Other meanings included are a fluff, mistake, interruption of plans and so on, and "glitches" characteristically can't be traced to or blamed on a particular person. Some would say glitch is a "gremlin-laid-on-hitch."

5—c Correct for movements of pitch-

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Are You A Bore?

A noted publisher in Chicago reports a simple technique of everyday conversation which can pay you real dividends in social and business advancement and works like magic to give you poise, self-confidence and greater popularity.

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ing and yawing. It is a rocket motor fastened on gimbals so that it can have rotation on either one of two mutually perpendicular axes. The gimballed rocket motor thus can correct for yaw or pitch of the ship.

6—a Ullage. The gravity effect from the small rocket firing, which pushes the liquid fuel down, introduces ullage—a volume space above the liquid. The term also applies to the ratio of this volume to the total volume of the tank.

7—b A plastic-like substance to dissipate heat on reentry. The substance is a special epoxy phenolic material used to cover the surface of the spacecraft. The ablating material vaporizes or is carried away by the intense heat developed at reentry of the earth's atmosphere. In the case of Apollo, its high reentry speed of 25,000 miles an hour requires shielding against temperatures of about 5,000°F.

8—a A model of full size and weight, but lacking most of the functional features. Another term widely used is mock-up, but this usually refers to a model built to scale.

9—b Point at which an artificial satellite in orbit is farthest from the earth. Of course the terms *apogee* and *perigee* apply to the natural satellite, the moon, too.

10—c Combinations of bipropellants which ignite spontaneously when they make contact with each other.

Score Yourself:

9—10 right— You're deep in space!
4— 8 right— At least you got into parking orbit.
0— 3 right— You're a burnout.

Discovering past cultures

The Maya World. Elizabeth P. Benson. Crowell. ($6.95).
Lords of Cuzco. Burr Cartwright Brundage. University of Oklahoma Press. ($6.95).

Judging from the number of archaeology books pouring off the presses these days, interest in the subject must be spreading rapidly. Somebody has to be buying all those books.

Two recent books which serve to measure the scope of interest are "The Maya World" and "Lords of Cuzco." Elizabeth P. Benson's "The Maya World" is a good introduction to these fascinating people. The information is well presented and well illustrated, and the author makes a successful attempt to simplify the complex and often confusing Maya culture. But basically the material in "The Maya World" would be familiar to anyone who had done much reading in the field.

Burr Cartwright Brundage's "Lords of Cuzco" is entirely another matter. Don't let the university press imprint scare you off. Of course, the book is elaborately annotated and documented, but the notes are in the back and do not interfere with the dramatic flow of the narrative, and this reconstruction of the Incas in the days before their final destruction is dramatic. In a description of the principal Inca city of Cuzco we read:

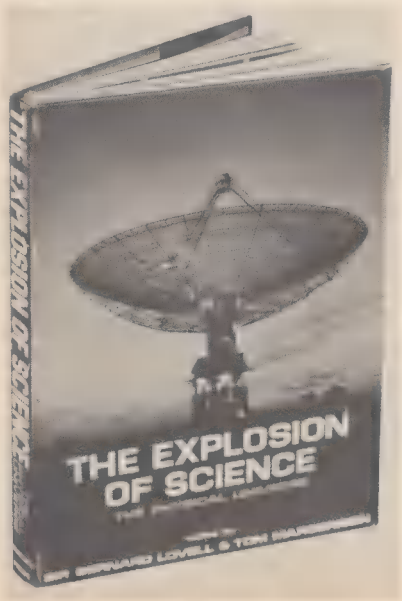
"The open area in front of Coricancha was called the Field of Pure Gold, Choqquepampa. Opening on it was a large pound or corral, a part of which was kept constantly filled with llamas of specified colors for sacrifice; the remainder of the pound was a separate area with shed-like constructions and huts within which were huddled those young boys and girls, ranging in age up to about 12, who were awaiting sacrifice on the hills round about. The whinnying and spitting of the llamas crowding together, shaking their tasseled ears and stamping, is contrasted with the awful silence from under the children's thatches. Customarily the priests came to inspect certain

of these children three times a year for the absolute purity and soundness of their bodies and to take away designated ones that they might be richly clothed, made drunk and then strangled. . . . They were children of many tongues and different races and were therefore unable to communicate with each other. All they had in common were their beauty and their destiny. The visitor today who stands on the public corner where the Pampa del Castillo opens onto San Domingo may strain his ears to catch again that uneasy shifting of animals muffling the silence of the motherless children in an effort to grasp the terrible intensity with which the Incas lived." —*D.C.*

Other new books of interest

Jet Streams. Elmar R. Reiter. Doubleday. ($5.95). The discovery of jet streams during World War II brought meteorology into a new era. The author tells how scientists have been able to solve the puzzle of jet streams and their effect on weather conditions.

The Star Lovers. Robert S. Richardson. The MacMillan Co. ($7.50). Men and women have watched the sky for years, trying to understand the stars. Sixteen famous astronomers and their observations are written about by a man who was on the Mount Wilson and Palomar Observatories staff for 25 years.



Bigger than ever

The Explosion of Science. Edited by Sir Bernard Lovell and Tom Margerison. Meredith Press ($24.95).

A few years ago the movie industry was pushing the slogan "Movies are better than ever." After being subjected to longer movies, on larger screens and at much higher prices, the report was, "Movies are bigger than ever." The same thing seems to be happening to science books. *The Explosion of Science* is a colorfully produced compendium of just about everything in the physical sciences. Science must be more popular, for this is strictly a coffee table item.

American Space Exploration. William Shelton. Little, Brown and Co. ($5.95). The trials and successes of America's first decade of astronautical efforts are recounted here by a man who was on hand for many of the space shots.

The Year 2000. Herman Kahn and Anthony J. Wiener. The Macmillan Co. ($9.95). Although obviously a study of the future and what can be expected by the year 2000, the authors here offer statistics and projections from such fields as economics, history, and political, social and physical sciences to back their picture of what's to come.

Seawatchers. William Bixby. David McKay Co., Inc. ($4.25). For the inside story of what oceanographers do on their journeys under the sea, one can join the crew of the research vessel *Chain* on a routine voyage.

The Science Century. Magnus Pike. Walker and Co. ($5.95). Man has seen scientific and technical advancement over the last 100 years he never dreamed possible. This is a study of scientific revolution and the way it has influenced modern life.

Famine on the Wind. G. L. Carefoot and E. R. Sprott. Rand McNally & Co. ($5.95). Parasitic plant diseases and their effect, in the past and the future, on the world's food supply and the health of humanity are carefully examined here.

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A noted publisher in Chicago reports there is a simple technique of rapid reading which should enable you to double your reading speed and yet retain much more. Most people do not realize how much they could increase their pleasure, success and income by reading faster and more accurately.

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Idea of the Month

Sound decay

WHILE he was studying the auditory problems of Philharmonic Hall in New York's Lincoln Center for the Performing Arts, Dr. Manfred R. Schroeder invented a sound decay meter.

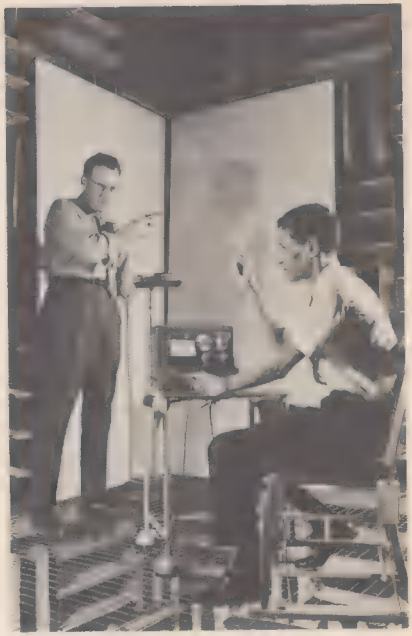
The rate at which sound decays, or declines, indicates the acoustic qualities of a concert hall or auditorium. The Philharmonic had had troubles with echoes, reverberations and the poor audibility of the cellos and double basses.

The sound decay instrument, shown at right, perfected after the Philharmonic research, has since been used for tests on a model of the new Metropolitan Opera House in New York and on a dozen halls and assembly rooms.

Knowledge of the decay rate is valuable in planning auditorium architecture and choosing materials.

Dr. Schroeder is director of the Acoustics, Speech and Mechanics Research Laboratory, a unit in the Bell Telephone Laboratories at Murray Hill, N.J. His instrument, for which he recently received Patent 3,343,627, obtains from a single sound, such as a pistol shot, a precise decay curve.

Because of random variations, decay curves plotted from one or a few experiments with sounds recorded in an auditorium had proved to be inaccurate. To take a great many observations and average



them would have been a cumbersome solution.

The single curve obtained with Dr. Schroeder's instrument represents the average of many. A filter and amplifier feed the pistol shot or other test signal into the hall being tested. Received in a microphone at another point in the chamber, the sound is analyzed by a computer. A graphic plotter or oscilloscope displays the result.

The inventor has degrees in physics from the University of Goettingen, and has been with Bell Labs since 1954. He is active in the Acoustical Society of America and the Audio Engineering Society, and has 34 United States patents pending or issued.

—Stacy V. Jones

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VORTEX Atom booklet with 1967 supplement on "The Duality of Particle and Wave". A centralized but non-nuclear system of atomic structure applicable to many of the unsolved problems of physics and chemistry, such as the unified field problem and the benzene ring problem. 36 pages with three-dimensional diagrams. 25 cents. C. F. Krafft, 4809 Columbia Rd., Annandale, Va. 22003.

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LETTERS TO SCIENCE DIGEST

A clever crow

In reference to the *Science Digest* article by Edward Edelson, "The 10 Smartest Animals," (Oct. '67), I see that the crow is listed, and I would like to say something about crows, especially the pet crow I used to have.

This crow was with us for five years and was seldom confined. During garden planting it was at times necessary to pen him up for a few days. The reasons are too obvious to mention. Only in the few coldest days of an especially cold winter did Zam wish to be inside. One winter day when he came inside we could see that he had a very bad cold. My mother suggested we give him cayenne pepper. As I went into our old-fashioned pantry to get the pepper from the spice drawer, the crow followed, meanwhile watching attentively all that went on. Thinking that he might reject the pepper if fed it directly, I put a few pinches on a small piece of bread, then moulded it into a good-size pill. This he swallowed whole. He was put down in the cellar in his cage and was much improved the next morning.

Now for the surprising part. The next winter, he again caught a bad cold. This time Zam walked into the

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(WE KNEW IT ALL THE TIME)

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"A philologist at the Ukrainian Academy of Science says that sleep-learning is less tiring to the brain than normal learning."

This "new" Russian discovery has been in use for over 2,000 years. In the United States sleep learning has been actively used since 1922 when Chief Radioman J. N. Phinney of the U.S. Navy successfully taught Continental Code during sleep. Since then, the use of sleep as a time for learning every kind of material, has become a reliable and accepted addition to our learning programs. The technique of sleep learning is being used by professionals, students and instructors, sales and corporate executives, housewives and mothers . . . along with many personalities in the public eye such as: Jan Sterling, José Ferrer, Red Buttons, Efrem Zimbalist, Jr., Sam Wanamaker . . . and many others — who use the time of sleep to absorb information effortlessly and painlessly for instant recall when awake.

To acquaint the readers of this newspaper with the simple techniques that allow constructive use of your sleeping hours, the Self-Development Research Foundation, a leading researcher in the field of learning while asleep, has published a compilation of Research Studies. These easy to understand reports tell you how to absorb any material while you sleep. Learn languages; learn to relax and control tensions; control your weight; sharpen your memory; develop your sales ability — all while you sleep, and without losing your rest.

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pantry, stood before the spice drawer and cawed excitedly. He somehow remembered the pepper cure. This time the crow took several beaks full of pepper directly from the pepper can and wanted to go to his cage in the cellar.

It's truly amazing to me what the "dumb" beasts will do at times.

GEORGE CARTER
Kendallville, Ind.

Egyptians, not Romans

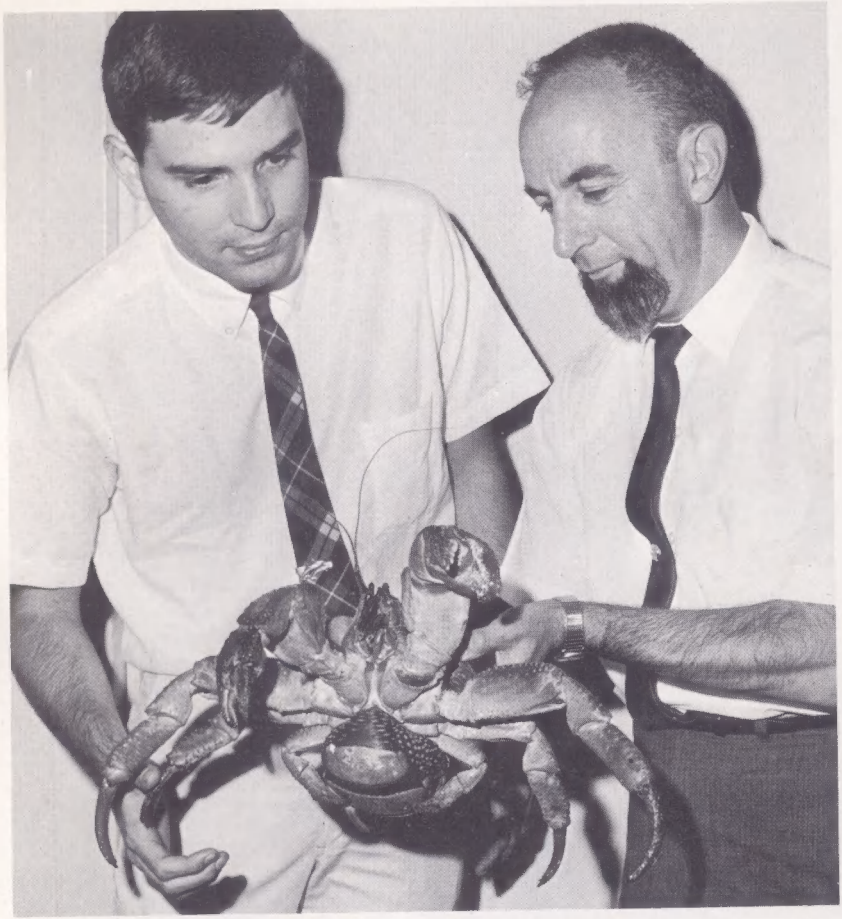
In the article, "To the Planets for Gold," (Oct. '67), the italicized banner at the top of page 41 reads, "It was cheaper for the Romans to let their miner-slaves die than it was to import food and water for them." The right-hand column of text attributes a description of the mines on Egypt's desert to the Roman historian, Diodorus, but clearly states: "Kush was so inaccessible that the Egyptians found it cheaper to replace the slaves as they died at their labors than to transport food to keep them alive."

I believe that the notation at the top of page 41 should have had the word "Egyptians" instead of "Romans."

I enjoy *Science Digest* very much. Best wishes for continued success and for the high caliber of articles which you print.

WESLEY H. SCHMIDT
Alexandria, Va.

The Roman miners did not fare too well, but Mr. Schmidt is right; it was the Egyptians who let the miner-slaves die.—Ed.



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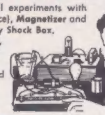

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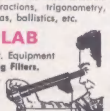
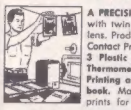


Measuring Wavelength of Light

PHOTOGRAPHY LAB



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Talking on a Light Beam

ATOMIC ENERGY LAB

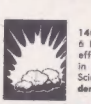
ATOMIC CLOUD CHAMBER WITH PROJECTOR ILLUMINATOR. See the vapor trails of alpha and beta particles, and of cosmic rays. **SPINTHARISCOPE.** Shows exploding atoms. **ELECTROSCOPE** — metal housed with **Scale** and **Magnifying Viewer.** Measures background radiation and tests sample sources. **SAFE RADIOACTIVE MATERIALS.** Alpha Source in handy container and Uranium Ore. **Full instructions and explanations open up the fascinating field of nuclear physics.**

Cloud Chamber

SPECTROSCOPE

Analyze spectra of glowing gases. See and identify the Fraunhofer Lines. A quality instrument featuring an **easy-to-read built-in scale and a powerful condensing system** for a bright spectrum. Equipment includes **Alcohol Burner** and a **2 Watt Neon Spectral Lamp. Full instructions cover theory and use.**

ULTRAVIOLET LAMP



140 watt filter type UV LAMP. Heavy metal cabinet. 6 Foot Cord, Rotary Switch. Produces dazzling color effects with invisible black light. Has many uses in the fields of Mineralogy, Crime Detection and Science. Accessories include **Invisible Ink, Tracer Powder, Fluorescent Crayons.**

SURVEYOR'S TRANSIT

A practical Transit. 6X erect image telescope with Range Finder Reticle for measuring remote distances and heights. Vernier reading for both horizontal and vertical scales. Leveling Head with Thumb Screw Adjustment and Spirit Level. Clamps under head hold wooden legs of Tripod. (Legs not included.) **Instructions cover elementary surveying, range-finding.**

TELESCOPE AND MOUNT

30X erect image. Extends to 30" length. Five ground and polished Lenses. **Ramsden Eyepiece. Sturdy Equatorial Mount** makes it easy to follow the movement of heavenly bodies. Mount has fittings for wooden legs that complete the tripod (legs are regular 1x2 lumber not included).

WEATHER STATION

A REMOTE READING ANEMOMETER AND WIND-VANE . . . Flashing Neon Lights on indoor indicator board show wind speed and direction. Operates on less than **1 cent per month. Safety Power Cord** makes all connections safe. 100 ft. of Lead-in Wire. Plus — **Air Tank Barometer** with 4 ft. indicator column. **Sling Psychrometer** measures relative humidity. **Rain Gauge** measures rainfall to 1/100 inch. ALSO Cloud Chart, Weather Map and Forecasting Manual — a complete set-up for amateur meteorology.

You get ALL the equipment for ALL the above in nine monthly kits

SEND ONLY **$1.00** TO ENROLL

PAY ONLY **$4.75** FOR EACH KIT THAT YOU RECEIVE

Take as few as you wish—or get all nine . . . it's up to you!

SOME QUESTIONS ANSWERED

Q. How is it possible? It seems incredible to be able to get all the equipment shown above in just nine kits — at only $4.75 per kit!

A. The low overhead of the membership plan is just part of the answer. The real key to this amazing program is ABSClub's especially designed multi-use equipment. For example: the Microprojector quickly and easily converts into the Spectroscope, Photo Enlarger and Cloud Chamber Illuminator. Similarly, the Transit Head doubles as a Telescope Mount. Such multi-purpose design makes possible this all-science program at a price everyone can afford.

Q. May members choose the order in which they receive their kits?

A. Yes. With the first kit members receive a list of the equipment and projects contained in each of the remaining eight kits. With this information they are able to choose the kit sequence that best suits their particular interest.

Q. Can members get their kits all at once instead of one-a-month?

A. Yes. At any time members can have the balance of their kits sent in one shipment. We recommend that you start on the kit-a-month plan because the monthly spacing will give you time to get the full measure of knowledge and enjoyment that each kit has to offer.

NO EXPERIENCE NECESSARY — IT'S FUN! IT'S EASY!

NO OBLIGATION—NO RISK!

- ★ **You take only as many kits as you wish.**
- ★ **All kits on 2 weeks approval.**
- ★ **You may return any kit for full refund.**

Send coupon today—get your first kit on its way!

TRIAL MEMBERSHIP COUPON

I wish to try the Kit-a-Month Program:

☐ I enclose $1.00 to enroll and $4.75 for the first kit **postpaid.**

☐ I enclose $1.00 to enroll. Send first kit COD. I'll pay COD fee.

I understand if I am not satisfied with the first kit I may return it for a complete refund including the $1.00 membership fee.

NAME

ADDRESS

CITY AND STATE (PLEASE PRINT) ZIP CODE

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